Collision with Trees and Crash Short of the Runway, Corporate Airlines Flight 5966 BAE Systems BAE-J3201, N875JX Kirksville, Missouri October 19, 2004

Aircraft Accident Report

NTSB/AAR-06/01

PB2006-910401
Notation 7694A

National Transportation Safety Board
Washington, D.C.

THE CORRECTIONS BELOW ARE *INCLUDED*
IN THIS VERSION OF THE PUBLISHED REPORT

AVIATION ACCIDENT REPORT
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CORPORATE AIRLINES, FLIGHT 5966
BAE SYSTEMS BAE-J3201, N875JX
KIRKSVILLE, MISSOURI
OCTOBER 19, 2004

- Page 27, first paragraph has been corrected to indicate 10 seconds instead of 19 seconds as originally printed. (7 MARCH 2006)
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Adopted January 24, 2006

National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2006. ***Collision with Trees and Crash Short of the Runway, Corporate Airlines Flight 5966, BAE Systems BAE-J3201, N875JX, Kirksville, Missouri, October 19, 2004.*** **Aircraft Accident Report NTSB/AAR-06/01. Washington, DC.**

Abstract: This report explains the accident involving Corporate Airlines flight 5966, a BAE Systems BAE-J3201, N875JX, that crashed short of the runway on approach to land at Kirksville Regional Airport, Kirksville, Missouri. Safety issues in this report focus on operational and human factors issues, including the pilots' professionalism and sterile cockpit procedures, nonprecision instrument approach procedures, flight and duty time regulations, fatigue, and flight data/image recorder requirements.

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Abbreviations

AC	advisory circular
AD	airworthiness directive
agl	above ground level
APOI	assistant principal operations inspector
ARFF	aircraft rescue and firefighting
ARTCC	air route traffic control center
ASOS	automated surface observation system
ATC	air traffic control
BRL	Southeast Iowa Regional Airport
C	celsius
CAM	cockpit area microphone
CAMI	Civil Aeromedical Institute
CFIT	controlled flight into terrain
CFR	Code of Federal Regulations
cg	center of gravity
CRM	crew resource management
CTAF	common traffic advisory frequency
CVR	cockpit voice recorder
DFDR	digital flight data recorder
DME	distance measuring equipment
DMORT	Disaster Mortuary Operational Response Team
DOT	Department of Transportation
EGPWS	enhanced ground position warning system
FAA	Federal Aviation Administration
FAF	final approach fix
FDR	flight data recorder
fpm	feet per minute
FSF	Flight Safety Foundation

FSS	flight service station
GPWS	ground proximity warning system
Hg	mercury
IC	incident commander
IFR	instrument flight rules
ILS	instrument landing system
IMC	instrument meteorological conditions
IRK	Kirksville Regional Airport
LEPC	Adair County Local Emergency Planning Committee
LPFD	LaPlata Fire Department
MAP	missed approach point
MDA	minimum descent altitude
MSA	minimum safe altitude
msl	mean sea level
MVFR	marginal visual flight rules
NDR	National Driver Registry
NIMS	National Incident Management System
nm	nautical mile
NPRM	notice of proposed rulemaking
NWS	National Weather Service
POI	principal operations inspector
S/N	serial number
SEP	Surveillance and Evaluation Program
sm	statute mile
STL	Lambert-St. Louis International Airport
TAWS	terrain awareness and warning system
TDZE	touchdown zone elevation
TWA	Trans World Airlines
UIN	Quincy Regional-Baldwin Airport
VASI	visual approach slope indicator
VFR	visual flight rules

Executive Summary

On October 19, 2004, about 1937 central daylight time, Corporate Airlines (doing business as American Connection) flight 5966, a BAE Systems BAE-J3201, N875JX, struck trees on final approach and crashed short of runway 36 at the Kirksville Regional Airport (IRK), Kirksville, Missouri. The flight was operating under the provisions of 14 *Code of Federal Regulations* Part 121 as a scheduled passenger flight from Lambert-St. Louis International Airport, in St. Louis, Missouri, to IRK. The captain, first officer, and 11 of the 13 passengers were fatally injured, and 2 passengers received serious injuries. The airplane was destroyed by impact and a postimpact fire. Night instrument meteorological conditions (IMC) prevailed at the time of the accident, and the flight operated on an instrument flight rules flight plan.

The National Transportation Safety Board determines that the probable cause of the accident was the pilots' failure to follow established procedures and properly conduct a nonprecision instrument approach at night in IMC, including their descent below the minimum descent altitude (MDA) before required visual cues were available (which continued unmoderated until the airplane struck the trees) and their failure to adhere to the established division of duties between the flying and nonflying (monitoring) pilot.

Contributing to the accident was the pilots' failure to make standard callouts and the current Federal Aviation Regulations that allow pilots to descend below the MDA into a region in which safe obstacle clearance is not assured based upon seeing only the airport approach lights. The pilots' unprofessional behavior during the flight and their fatigue likely contributed to their degraded performance.

The safety issues in this report focus on operational and human factors issues, including the pilots' professionalism and sterile cockpit procedures, nonprecision instrument approach procedures, flight and duty time regulations, fatigue, and flight data/image recorder requirements.

1. Factual Information

1.1 History of Flight

On October 19, 2004, about 1937 central daylight time,[1] Corporate Airlines (doing business as American Connection)[2] flight 5966, a BAE Systems BAE-J3201, N875JX, struck trees on final approach and crashed short of runway 36 at Kirksville Regional Airport (IRK), Kirksville, Missouri. The flight was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 as a scheduled passenger flight from Lambert-St. Louis International Airport (STL), in St. Louis, Missouri, to IRK.[3] The captain, first officer, and 11 of the 13 passengers were fatally injured, and 2 passengers received serious injuries. The airplane was destroyed by impact and a postimpact fire. Night instrument meteorological conditions (IMC) prevailed for the flight, which operated on an instrument flight rules (IFR) flight plan.

The flight crew was on a regularly scheduled 4-day sequence that began on Sunday, October 17, 2004. The accident occurred on the last flight of the third day, which departed from STL about 1842. Based on air traffic control (ATC) and cockpit voice recorder (CVR)[4] information and Corporate Airlines dispatcher statements, the departure and en route phases of the accident flight were routine; the captain was the flying pilot and the first officer was the nonflying/monitoring pilot.[5]

When the flight was about 23 minutes from its destination, the pilots listened to the IRK automated surface observing system (ASOS) weather information, which indicated a wind from 040° at 6 knots, visibility 4 miles in mist, ceiling[6] overcast at 300 feet above ground level (agl), temperature and dew point 9° Celsius (C), and an altimeter setting of 29.95 inches of mercury (Hg). After hearing the weather observation, the captain commented, "we're not getting in...we don't have an ILS [instrument landing system]."[7] The first officer responded, "I know…go all this [expletive] way. Well, let's try it." The captain responded, "yeah, we'll try it." About 30 seconds later, the captain said, "I don't

[1] Unless otherwise indicated, all times are central daylight time, based on a 24-hour clock.

[2] In February 2005, Corporate Airlines was renamed Regions Air, Inc. For the purposes of this report, the name Corporate Airlines will be used.

[3] IRK is located in northeastern Missouri, about 162 miles northwest of STL.

[4] The CVR recorded the last 30 minutes and 12 seconds of cockpit communications before the accident. See appendix B for a transcript of the CVR recording.

[5] In its February 2003, advisory circular (AC) 120-71A, the FAA emphasized the importance of the nonflying pilot's role in monitoring and crosschecking, especially during critical phases of flight like the approach and landing.

[6] The cloud ceiling is the lowest layer of clouds reported as broken or overcast, or the vertical visibility into a surface-based obscuration.

[7] The ILS is a precision instrument landing system that provides horizontal and vertical flightpath guidance to the pilot.

want to…go all the way out here for nothing tonight," and moments later said, "I'll be so happy when we have an ILS everywhere we go." The first officer concurred, and the captain continued, "I thought we were gonna have it easy tonight."

According to ATC, radar, and CVR information, the flight was at 12,000 feet mean sea level (msl) and about 20 minutes from the destination airport when the Kansas City air route traffic control center (ARTCC) asked the pilots which approach they wanted into IRK. The pilots requested vectors for the localizer DME[8] approach to runway 36 at IRK. The controller acknowledged the pilots' request and cleared them to descend from 12,000 to 8,000 feet msl "at pilot's discretion." The pilots acknowledged the clearance and began the descent checklist. The ARTCC controller advised the pilots to fly their present heading (which was about 300°) and to expect radar vectors for the localizer DME approach to runway 36.

About 1920:06, the pilots again listened to the IRK ASOS weather information, which then indicated a wind from 040° at 5 knots, visibility 3 miles in mist, ceiling overcast at 300 feet agl, temperature and dew point 9° C, and an altimeter setting of 29.95 inches Hg. The first officer sighed, then stated, "it's three miles and mist now," and sighed again. The captain responded, "Really?…so it's going down the tubes."

Flight data recorder (FDR) data indicated that the airplane descended through 10,000 feet msl (bringing into effect sterile cockpit rules)[9] about 1921:24. As the airplane further descended to 8,000 feet msl, the ARTCC controller cleared the pilots to descend at their discretion to and maintain 3,000 feet msl. The pilots acknowledged the clearance, and the captain briefed the approach,[10] stating, "one eleven point five, three fifty seven's the inbound. Twenty five hundred at KEMMY.[[11]] Thirteen twenty is our MDA [[12]], and we have a three hundred sixty foot approach set in the radar altimeter…nine sixty six for the airport elevation, nine sixty four is the touchdown zone elevation [TDZE]. Speeds as previously briefed, fifteen, twenty one, and thirty. If we have to go missed we'll set max power, flaps ten, positive rate, gear up…and we'll climb to three thousand feet then direct Kirksville VOR,[[13]] and hold."

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8 DME (distance measuring equipment) is expressed in nautical miles.

9 For additional information regarding sterile cockpit regulations, see section 1.18.1.

10 Figure 4, in section 1.10, is an approach chart depicting the localizer DME approach to runway 36 at IRK.

11 KEMMY was the final approach fix for the localizer DME approach to runway 36 at IRK and was located about 5.2 DME miles south of the approach end of the runway.

12 The MDA (minimum descent altitude) is a specified altitude in a nonprecision approach or circling approach below which descent must not be made unless the pilots have visual contact with the runway environment. The MDA at IRK was 1,320 feet msl. The Corporate Airlines flight manual defines visual contact with the runway environment as visual contact with any of the following: the approach light system; the visual approach slope indicator; runway end identification lights; the runway threshold, threshold markings, or threshold lights; runway lights; touchdown zone lights; touchdown zone or zone markings; or the runway or runway markings.

13 VOR refers to the very high frequency omnidirectional radio range navigation aid.

As the airplane began to descend into the top of the clouds, the CVR recorded the captain stating, "…we're going into the crap. Look, ooh, it's so eerie and creepy…get a suffocating feeling when I see that." The first officer made a barking sound followed by a groan, and, about 1925:13, the captain continued, stating, "I'm drowning…,"[14] then he remarked, "MSA[[15]] is thirty one hundred." The first officer responded, "correcto mundo." About 25 seconds later, CVR recorded a yawn on the first officer's channel,[16] then he stated, "they have a VASI [visual approach slope indicator] on the left hand side," and the captain responded, "yeah. Wish we had an ILS on the front side." The first officer said, "yeah, that'd be nice."

When the airplane was about 10 minutes from its destination, the ARTCC controller advised the pilots to turn 10° to the right to intercept the localizer for runway 36 at IRK. The pilots complied, turning to a heading of 310.° About 2 minutes later, the captain asked, "how's…Kirksville looking weather wise? Getting any worse?" The pilots again listened to the IRK ASOS weather information, which indicated a wind from 030° at 6 knots, visibility 3 miles in mist, ceiling overcast at 300 feet agl, temperature and dew point 9° C, and an altimeter setting of 29.95 inches Hg. The captain stated, "temp [and] dew point's right where you don't want it," and the first officer responded, "yeah…still three hundred."

The pilots performed the approach checklist as the airplane descended and leveled off at 3,100 feet msl. About 1930:35, the ARTCC controller told the pilots they were 11 miles south of the final approach fix (FAF) for the localizer DME approach to runway 36 at IRK. He advised them to turn right to a heading of 330° and maintain an altitude of 3,000 feet msl until they were established on the localizer, then cleared them for the localizer DME approach to runway 36 at IRK. The pilots complied and the first officer advised the captain that the localizer course was "alive."[17] The captain stated, "Let's go flaps ten and we'll configure early…give ourselves as much time as we can." The first officer agreed and selected and verified 10° of flaps as the airplane intercepted the final approach course.

Less than 1 minute later, the captain confirmed with the first officer that they could descend to 2,500 feet msl at that point in the approach, then asked the first officer to extend the landing gear, select 20° of flaps, and perform the before landing checklist. About 1932:48, the first officer stated, "gear down…flaps selected indicating twenty" and continued the before landing checklist. About 1933:40, the ARTCC controller approved a frequency change (to the IRK common traffic advisory frequency [CTAF]) and advised the pilots to report after they landed. The first officer acknowledged the instructions and,

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[14] For additional information on the pilots' conversation, see section 1.18.1 and the CVR transcript in appendix B.

[15] The MSA (minimum safe altitude) depicted on the approach chart ensures at least 1,000 feet of obstacle clearance within a 25-mile radius of the pertinent facility.

[16] The CVR recorded additional yawning sounds by both the captain (about 1915:03) and the first officer (about 1923:43, 1925:44, and 1929:27) during the flight.

[17] Pilots commonly use the term "alive" to indicate the movement of the localizer needle that occurs as the airplane nears the localizer course.

at the captain's request, keyed the microphone to activate the pilot-controlled runway lights at IRK.[18]

According to FDR, CVR, and radar data, the airplane was at 2,500 feet msl when it crossed the FAF at 19:35:36, and the first officer advised the captain that they could descend to 1,320 feet msl, the MDA for the approach. The captain acknowledged, stating, "thirteen twenty, here we go." Radar and calculated FDR data indicated that the airplane then began to descend about 1,200 feet per minute (fpm) while tracking the localizer. About 1936:23, as the airplane descended through about 1,600 feet msl, the first officer stated, "five hundred, four hundred to go." About 17 seconds later (at 1936:30.6), as the airplane descended through about 1,450 feet msl (about 500 feet agl), the CVR recorded the airplane's ground proximity warning system's (GPWS) mechanical announcement, "five hundred."

At 1936:33.9, as the airplane descended through about 1,380 feet msl, the first officer stated "thirteen twenty." The captain thanked him and about 3 seconds later (as the airplane reached the MDA), stated, "I can see ground there."[19] As he finished speaking, the GPWS annunciated, "minimums, minimums," indicating that the airplane had reached 1,320 feet msl. Calculated FDR data indicated that the airplane continued to descend at a rate of about 1,200 fpm. At 1936:40.5, the captain asked, "what do you think?," and the first officer responded, "I can't see [expletive]." About 2 seconds later, as the airplane continued to descend, the captain stated, "yeah, oh there it is. Approach lights in sight." Almost immediately, the GPWS annunciated "two hundred" feet agl and the first officer stated, "…in sight…continue." The airplane was descending through about 1,160 feet msl (160 feet below the MDA) at this time.

As the pilots continued the approach, still descending about 1,200 fpm, the first officer asked the captain if he wanted the flaps extended to 35.° At 1936:52.2, the captain responded, "no," and the GPWS began to announce, "sink rate."[20] One second later, the first officer exclaimed, "trees," and the captain stated, "no, stop." The first sounds of impact with the trees were recorded at 1936:55.2, and numerous sounds of impact were recorded before the CVR stopped recording at 1936:57.5.

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[18] During nighttime hours, all runway, taxiway, and approach lighting at IRK is pilot-controlled and activated by a pilot keying the microphone with the radio tuned to the airport's CTAF. Keying the airplane microphone activates the airport lighting as follows: three times (within 5 seconds) results in low intensity, five times results in medium intensity, and seven times results in high intensity. The captain requested high-intensity airport lighting for the accident approach; the first officer activated the airport's lighting system accordingly and confirmed the activation with ground personnel at IRK.

[19] According to Corporate Airlines procedures and training, when the airplane reaches the MDA during an instrument approach, the flying pilot is to level off and monitor the flight instruments while the nonflying pilot looks outside the airplane for visual cues to determine whether the descent can be continued.

[20] The accident airplane's GPWS was designed to provide a "sink rate" alert when, based on its altitude and rate of descent, the airplane penetrated the GPWS system's alert envelope. According to the GPWS design, the airplane would have penetrated the alert envelope as it descended through about 100 feet agl at a 1,200 fpm rate of descent.

FDR and radar data and the National Transportation Safety Board's airplane performance study[21] indicated that the airplane maintained a relatively constant heading and flightpath angle during the descent from the FAF until the pilots saw the trees immediately before the initial impact occurred. At that time, the Safety Board's performance study indicated a reduction in the airplane's descent rate and increases in airplane nose up elevator movement and vertical acceleration. Physical evidence showed that the airplane first contacted the trees more than 1.3 nautical mile (nm) south of the approach end of runway 36, about 50 feet agl (about 996 msl), and continued descending through trees toward the runway. The airplane came to rest with the forward fuselage aligned on about a 190° heading and the aft fuselage on about a 240° heading. The main wreckage site was located about 775 feet north of the initial impact site and about 1.2 nm south of the approach end of runway 36.

1.2 Injuries to Persons

Table 1. Injury chart.

Injuries	Flight Crew	Cabin Crew	Passengers	Other	Total
Fatal	2	0	11	0	13
Serious	0	0	2	0	2
Minor	0	0	0	0	0
None	0	0	0	0	0
Total	2	0	13	0	15

Note: Title 14 CFR 830.2 defines a serious injury as any injury that (1) requires hospitalization for more than 48 hours, starting within 7 days from the date that the injury was received; (2) results in a fracture of any bone, except simple fractures of fingers, toes, or the nose; (3) causes severe hemorrhages or nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns or any burns affecting more than 5 percent of the body surface.

1.3 Damage to Aircraft

The airplane was destroyed by impact forces and a postimpact fire.

1.4 Other Damage

Trees along the wreckage path were damaged by impact forces and a postimpact fire.

[21] For additional information regarding the Safety Board's airplane performance study, see section 1.16.1.

1.5 Personnel Information

The flight crew consisted of a captain and a first officer, who had flown together since their October schedule began on October 3. The captain and first officer commuted from their homes in New Jersey and Ohio, respectively, to report for duty at STL about 1345 on October 17 for the first flight of the trip sequence. The pilots arrived at their overnight destination, Quincy Regional-Baldwin Airport (UIN) in Quincy, Illinois, about 2125. According to the flight logs, the pilots flew three flights on October 17 for 3 hours and 3 minutes of flight time and 7 hours and 55 minutes of duty time.[22] On Monday, October 18, the pilots departed UIN about 1415 after more than 15 hours off duty. They arrived at their overnight destination, Southeast Iowa Regional Airport (BRL) in Burlington, Iowa, about 1945. According to the flight logs, the pilots flew four flights on October 18 for 3 hours and 36 minutes of flight time and 6 hours and 21 minutes of duty time.

On the third day of the trip sequence (October 19), the pilots' duty period began about 0514 at BRL after about 9 hours off duty.[23] They departed on the first flight of the day about 0544 and flew to STL, where they arrived about 0644. The pilots were originally scheduled to depart STL again about 0930, fly to UIN and then return to STL; however, those two flights were cancelled because of poor weather conditions.[24] They then resumed their normal flight schedule, departing STL again about 1236. They flew to IRK and returned to STL, where they arrived about 1453. The pilots departed STL again about 1513, flew to BRL, and returned to STL, where they arrived about 1745. The accident flight departed STL about 1842. The pilots were flying their sixth flight of the day and had flown about 6 hours and 14 minutes in 14 hours and 31 minutes of duty time when the accident occurred. Figure 1 is a graph showing the estimated duty schedules for both pilots and the estimated sleep schedule

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[22] For planning/scheduling purposes, Corporate Airlines added 30 minutes of duty time before the morning departure time and 15 minutes of duty time to the arrival time to account for pre- and post-flight paperwork and duties. Because a pilot's duty time begins when he or she begins preflight duties before the first flight of the day and ends after he or she has completed postflight duties after the last flight, the duty times documented in the flight log exceeds the time between the beginning of the first flight to the end of the last flight of the day. According to 14 CFR 121.471, flight crews flying domestic Part 121 operations may fly up to 8 hours between required rest periods, 30 hours per week, 100 hours per month, and 1,000 hours per year. If the scheduled flight time is less than 8 hours, the minimum rest period in the 24 hours preceding the scheduled completion of the flight segment is 9 hours. If the scheduled flight time is 8-9 hours, the minimum rest period in the 24 hours preceding the scheduled completion of the flight segment is 10 hours. If the scheduled flight time is equal to or greater than 9 hours, the minimum rest period in the 24 hours preceding the scheduled completion of the flight segment is 11 hours. These minimum rest periods may be reduced if the following rest periods, to begin no later than 24 hours after the commencement of the reduced rest period, are increased to 10, 11, and 12 hours, respectively.

[23] Hotel records indicate that, on the day of the accident, the captain and first officer received wakeup calls at 0410 and 0430, respectively.

[24] According to Corporate Airlines personnel, a captain and a dispatcher will often consult and agree to cancel a flight or flights. However, in this case, the Corporate Airlines dispatcher independently cancelled the roundtrip flight between STL and UIN because of the weather conditions. The weather at UIN was low IFR and the airport's ILS was out of service.

for the captain.[25] Figure 2 is a map of the region where the accident occurred, with pertinent airport locations shown.

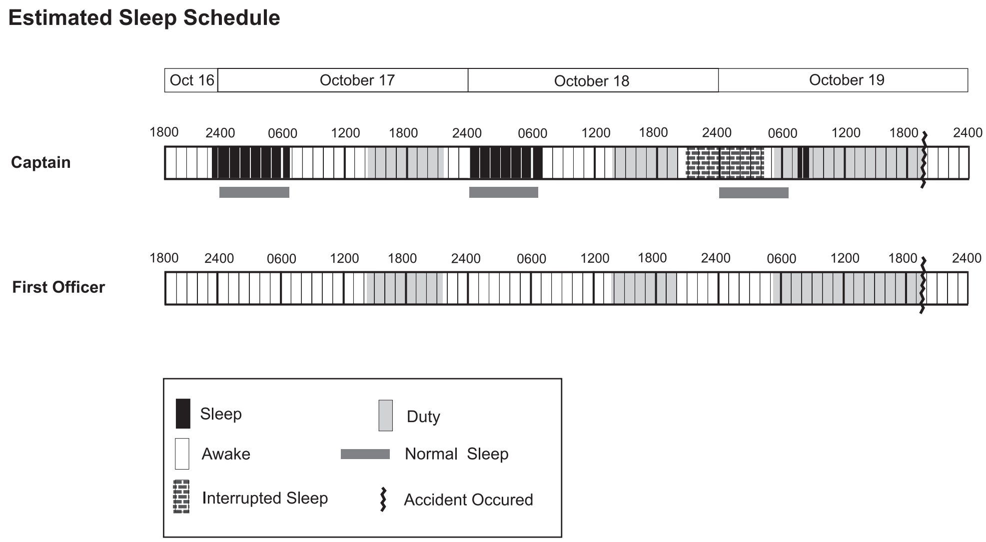

Figure 1. The estimated duty schedules for both pilots and the estimated sleep schedule for the captain.

Figure 2. Map of the accident region, with pertinent airport locations shown.

[25] Information about the pilots' schedules was derived from company records, telephone records, hotel records, and interviews with the captain's fiancée, the first officer's mother, and other pilots (friends and coworkers). The captain told his fiancée that he had not slept well the night before the accident and that he had a headache that morning. Information about the first officer's sleep schedule during the trip sequence was limited.

1.5.1 The Captain

The captain, age 48, began flying in the late 1980s and obtained his flight instructor certificate in 1991. Because of limited job opportunities in aviation, he subsequently worked in non-aviation positions in the computer industry. In September 1999, the captain left a job in the computer industry to return to the aviation industry as a flight instructor. Corporate Airlines hired him as a BAE-J3201 first officer on March 20, 2001. At the time of the accident, the captain held an airline transport pilot certificate (issued August 26, 2003) with airplane multiengine land ratings and a type rating in the BAE-3100.[26]

According to Corporate Airlines training records, the captain was upgraded from first officer to captain on the BAE-J3201 on September 17, 2003. The captain's most recent Federal Aviation Administration (FAA) first-class airman medical certificate was issued on June 22, 2004. Table 2 shows the captain's most recent training, proficiency and line checks, and flight experience.

Table 2. Captain's recent training, proficiency and line checks, and flight experience.

Recurrent training	June 13 and 15, 2004[a]
Recurrent ground training	July 7, 2004[b]
Proficiency check	July 16, 2004
Line check	September 28, 2004
Total flight time	4,234 hours
BAE-J3201 flight time	2,510 hours
Flight time last 90 days	191 hours
Flight time last 30 days	72 hours
Flight time last 24 hours	6 hours

a. During the June 13, 2004, recurrent training, the captain failed two items (takeoff with a loss of engine power after the airplane reached takeoff decision speed and single-engine ILS approach). He was retested on June 15, 2004, and passed.
b. Corporate Airlines records indicate that the captain received controlled flight into terrain (CFIT) training during this recurrent training.

A review of FAA records found no accident, incident, or enforcement actions, and a search of the National Driver Registry (NDR) database indicated no record of driver's license suspension or revocation.

Postaccident interviews with four Corporate Airlines pilots who had flown with the captain revealed that they considered the captain to be a competent pilot who followed

[26] This type rating included the BAE-J3201 airplane.

procedures. Pilots also described the captain as a relaxed, intelligent, and friendly person with a sense of humor.

The captain's fiancée characterized the captain's health as good and indicated that no major changes had occurred in his health, eating or sleeping habits,[27] off-duty activities, or financial situation in the year before the accident.[28] The captain's fiancée told investigators that flying for Corporate Airlines was the captain's first major aviation job and he loved it. According to several pilot friends, the only complaint the captain had about Corporate Airlines was the lack of an autopilot on the BAE–J3201, which resulted in pilots having to fly the airplanes manually through any weather and workload.[29] At the time of the accident, the captain anticipated a job interview with a major airline[30] and was reportedly very happy.

According to the captain's fiancée, the captain went to bed between 2300 and midnight on Friday, October 15 and awoke between 0630 and 0700 on Saturday, October 16. She stated that they spent a routine day at home. He did laundry and got clothes organized for his upcoming trip sequence; they shopped and did some basic maintenance around the house. She estimated that he went to bed about midnight Saturday night and woke up about 0700 on Sunday, October 17. According to the captain's fiancée, they ate breakfast together before he left home about 0800 to commute to STL.

Hotel records indicated that after the last flight of the day on Monday, October 18, the captain checked into the hotel at Burlington, Iowa, about 2020. According to the hotel desk clerk who checked him in, the captain indicated that he was going directly to bed because the next day was a long flight day. The captain's telephone records indicated that he called his fiancée about 2027 that night and the call duration was about 8 minutes.

During postaccident interviews, a Corporate Airlines pilot told investigators that he observed the captain resting on a small couch[31] when he was in the company crew room at STL for about 45 minutes in the morning (starting about 0730 or 0800) on October 19. The Corporate Airlines pilot indicated that when he returned to the crew room

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[27] The captain's fiancée reported that when he did not have work demands, the captain normally went to bed about midnight and woke up about 0630 to 0700. She indicated that his sleep patterns during the days leading up to this trip sequence were consistent with this habit.

[28] According to the captain's fiancée, they had known each other for 9 years and lived together for the past 3 years.

[29] According to a BAE Systems representative, the accident airplane was designed with an autopilot system as an optional feature; none of Corporate Airlines BAE-J3201 airplanes had autopilots installed.

[30] A former Corporate Airlines pilot and long-time friend of the captain's flew for a larger airline at the time of the accident and was helping the captain get an interview with that company.

[31] The Corporate Airlines pilot told investigators that there were three couches in the crew rest room—a long couch, a "regular"-size couch, and a small couch. The pilot stated that the captain, who was 6'4" tall (according to his flight physical), was curled up on the small couch. Several company pilots described the crew room as a noisy meeting area that is not ideal for sleeping.

about 1030 or 1100, he saw the captain resting on the same couch.[32] He stated that the captain and first officer left shortly after that to have lunch with other pilots.[33]

The captain's fiancée stated that when they spoke that morning, the captain told her that he had not slept well in the hotel the night before and that he had awakened with a headache. He also discussed the bad weather they were experiencing[34] and mentioned that some of his flights for the day had been cancelled. The captain also told his fiancée that he liked the first officer, enjoyed flying with him, and remarked that he was quite skilled. The captain stated that he and the first officer worked well together.

When asked about the flight schedules at Corporate Airlines, the captain's fiancée stated that the captain had mixed feelings about the schedules; he enjoyed being home for 3 days, but he thought some of the flight days (specifically those involving eight flight legs) were long. She said he loved to fly and never mentioned being tired. She indicated that when the captain was away on a trip he did not typically go to bed immediately after the last flight of the day. Rather, it was his habit to have a nice dinner and get things ready for the next day before going to sleep. She said that he did not have any real issues with the schedule.

1.5.2 The First Officer

The first officer, age 29, obtained his private pilot certificate in 1994 and his commercial and flight instructor certificates in 1996. According to the company's records, the first officer worked as a flight instructor at Eastern Cincinnati Aviation from July 1996 to August 2004. In addition, from July 2000 to June 2002, the first officer attended the Embry-Riddle Aeronautical University extended campus in Cincinnati, Ohio. Within this time period (from February 2001 to October 2001), the first officer also worked as a first officer at Sunworld International Aviation, based in Florence, Kentucky. In October 2001, he was furloughed from Sunworld, after having flown 86 hours for the company. Corporate Airlines hired the first officer on July 19, 2004.[35] The first officer held a

[32] Telephone records indicated that the captain was not resting continuously between these observations; on the day of the accident, numerous calls were made from and received on the captain's telephone between 0900 and 1230.

[33] If the roundtrip between STL and UIN had not been canceled that morning, the pilots would have been flying from UIN to STL about this time. The first officer's mother told investigators that he often packed sandwiches in advance because this trip sequence did not provide the pilots with enough time to eat between flights. It is unknown what the pilots had for lunch; however, during the flight to IRK the captain discussed food. About 1912:51, the CVR recorded him stating, "All I'm thinking of is a Philly [expletive] cheesesteak and an iced tea."

[34] Several Corporate Airlines pilots that were interviewed after the accident indicated that the weather around STL during those three days (October 17 through 19) was bad, with consistently low ceilings and visibility; one pilot indicated that it was "among the worst" he had experienced in a long time and that weather had frequently been worse than forecast at the destination.

[35] The first officer's employment records indicate an overlap between his hire date at Corporate Airlines (July 19, 2004) and his resignation at Eastern Cincinnati Aviation (August 2004). Although the first officer would have attended Corporate Airlines training in STL during this time, it is possible that he worked with flight students at Eastern Cincinnati Aviation on weekends.

commercial pilot certificate with airplane multiengine land and instrument ratings (issued December 19, 1999). The first officer's most recent FAA first-class airman medical certificate was issued on February 17, 2004. Table 3 shows the first officer's initial training, proficiency check, and flight experience.

Table 3. First officer's initial training, proficiency check, and flight experience.

Initial training	August 15, 2004[a]
Proficiency check	August 15, 2004
Total flight time	2,856 hours
BAE-J3201 flight time	107 hours
Flight time last 90 days	107 hours
Flight time last 30 days	72 hours
Flight time last 24 hours	6 hours

a. Corporate Airlines records indicated that the first officer received CFIT training during his initial training/BAE-J3201 proficiency check.

A review of FAA records found no accident, incident, or enforcement actions, and a search of the NDR database indicated no record of driver's license suspension or revocation.

During a postaccident interview, the company chief pilot described the first officer as upbeat, hard-working, and ready with a joke. According to several witnesses, the first officer was happy with his job at Corporate Airlines and hoped to advance to a larger airline in a few years. Several witnesses indicated that the first officer enjoyed flying with the captain.

The first officer lived in Cincinnati, Ohio, with his mother. The first officer's mother characterized his health as good and indicated that no major changes had occurred in his health, eating, or sleeping habits,[36] off-duty activities, or financial situation in the year before the accident. According to his mother, when he was working, the first officer normally left home on Sunday morning, flew his schedule, and returned home Wednesday evening. He did not normally call home when he was gone. She stated that, although the first officer took a reduction in pay when he accepted the job at Corporate Airlines, he was satisfied because he saw the Corporate Airlines job as an entry path to the major airlines and a way to "build valuable flight time." The first officer's mother told investigators that her son had mentioned the accident captain favorably and indicated that they had a lot in common. He told her that he and the captain planned to ask to fly together again in the upcoming month.

The first officer's mother told investigators that he seemed normal in the days leading up to the accident trip sequence. According to his mother, on Thursday, October 14, the first officer watched rented movies with a pilot friend and went to bed about 2230. She indicated that on Friday, October 15, he went out with friends and that she was asleep when he returned, so she did not know what time he went to bed. She stated that on Saturday,

[36] The first officer's mother reported that when he did not have work demands, the first officer's sleep schedule was variable, depending on social and flight instruction obligations. She indicated that he occasionally had difficulty sleeping.

October 16, he came home early from visiting friends, they spoke briefly, and he went to his bedroom about 2230. According to the first officer's mother, she had not yet seen him the next morning (Sunday, October 17) when she left the house about 0725.[37]

The first officer's mother told investigators that her son mentioned that the flight schedule on the day of the accident typically resulted in a long day. According to several pilots who spoke with the first officer that day, he seemed alert and happy.

1.6 Airplane Information

Records indicated that the accident airplane, N875JX, a BAE Systems BAE-J3201 airplane, serial number (S/N) 875, was ordered by Nashville Eagle and delivered to that company in February 1990. Nashville Eagle operated the airplane until March 1994, when it was reregistered and leased to Trans State Airlines (part of Trans World Express fleet [or TWA]). Corporate Airlines began to operate the airplane under a code share agreement with TWA on April 26, 2000, and continued operating the airplane under a code share agreement with American Airlines after American Airlines acquired TWA. At the time of the accident, the accident airplane had accumulated about 21,979 flight hours and 28,973 cycles.[38]

The accident airplane was equipped with two Honeywell TPE331 engines, rated at 1,100 horsepower, and two McCauley propeller assemblies. The left engine had accumulated about 12,919 hours total flight time, including about 342 hours since its most recent overhaul and its installation on the accident airplane. The right engine had accumulated about 21,583 hours total flight time, including about 2,774 hours since its most recent overhaul and its installation on the accident airplane. Both engines underwent their most recent inspections about 56 hours before the accident.

On the basis of Corporate Airlines dispatch records, the Safety Board calculated that the airplane's estimated landing weight was 15,185 pounds, including about 2,989 pounds of payload (passengers and cargo) and about 1,688 pounds of fuel. The airplane's maximum allowable landing weight was 15,609 pounds. Calculations showed that the airplane's center of gravity (cg) was within approved cg limits during all phases of the accident flight.

The accident airplane was configured with 19 passenger seats in the cabin and 2 flight crew seats in the cockpit.[39] The passenger seats comprised seven single seats along the left cabin wall and six sets of double seats along the right cabin wall. The main cabin

[37] The first officer's mother indicated that he needed to leave home about 0900 or 1000 to commute to STL for the trip sequence.

[38] An airplane cycle is one complete takeoff and landing sequence.

[39] Because of its maximum payload and number of passenger seats, Corporate Airlines was not required to provide flight attendants on the BAE-J3201; therefore, there was no flight attendant jumpseat on the airplane. (According to 14 CFR 121.391, operators must provide at least one flight attendant for airplanes having a maximum payload capacity of 7,500 pounds or more and having a seating capacity of more than 19 but less than 51 passengers.)

door was located on the left side of the cabin behind the farthest aft passenger seat. There were overwing emergency exits at row 4 on both sides of the cabin. Figure 3 is a diagram of the airplane's cabin and cockpit configuration.

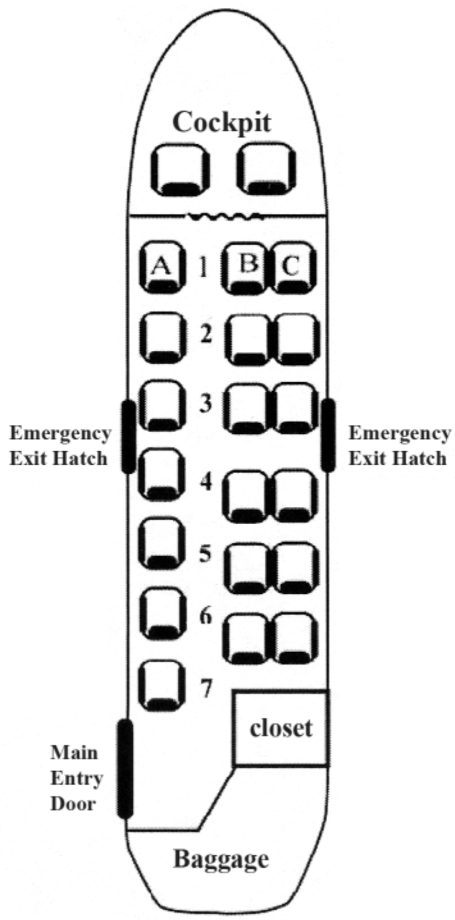

Figure 3. Diagram of the accident airplane's cabin and cockpit configuration.

1.7 Meteorological Information

1.7.1 Official Kirksville Weather Information

IRK is equipped with an ASOS, which continuously measures wind direction and speed,[40] visibility, present weather (for example, precipitation and obstructions to vision), sky condition (cloud height and sky cover), temperature, dew point temperature, and altimeter setting. National Weather Service (NWS)-certificated weather observers augment this automated weather observation system as needed.

[40] The ASOS station samples wind direction and speed every 5 seconds and records a 2-minute average wind direction and speed every minute.

The ASOS observation at 1935:31 (closest to the time of the accident) reported wind from 020° at 6 knots, visibility 4 statute miles (sm) in mist, ceiling overcast at 300 feet agl, temperature and dew point temperature at 9° C, and an altimeter setting of 29.96 inches Hg. The Safety Board's review of the 5-minute ASOS observations for IRK from 1900:31 to 1955:31 revealed visibilities that varied between 3 and 5 miles in mist[41] and ceilings that varied between 300 and 500 feet agl.

The NWS surface analysis chart for the time of the accident showed a cold front that extended west-southwest from western Kentucky through a low pressure area located in western Missouri, southern Oklahoma, and northern Texas. Information on this chart indicated an extensive area of clouds and precipitation along and north of the frontal boundaries across the region.

The NWS weather depiction chart for 2000 (just after the accident) showed a large area of IFR weather conditions[42] throughout Illinois and northeastern Missouri (including the accident site). Marginal visual flight rules (MVFR)[43] weather conditions were depicted over western and southern Missouri and a portion of Iowa. The weather observations on the regional weather depiction chart showed visibilities between 2.5 and 4 sm in mist, with overcast ceilings between 300 and 800 feet throughout northeastern Missouri and western Illinois.

Review of the weather data for the region revealed no evidence of precipitation echoes, convective activity, or conditions conducive to inflight ice accumulation, significant turbulence, or low level windshear along the route of flight or at the accident site.

1.7.2 Kirksville Weather Information Provided by Witnesses

The Safety Board interviewed several pilots who landed and/or took off at IRK before and after the accident, all of whom described weather conditions consistent with the ASOS observations around those times. For example, a pilot who landed in a Cessna 182 airplane about 1840, a little more than an hour before the accident, stated that he flew the localizer DME approach to runway 36 at IRK in "smooth," "solid IMC" conditions. He stated that he broke out of the clouds about 1,600 feet msl (534 feet agl) and the visibility was 4 miles in mist.

The Safety Board also received a statement from the pilot of a Gulfstream jet (N720DR) who flew the same approach and landed at IRK about an hour after the accident. He stated that after the airplane crossed the FAF, he descended to the MDA. The copilot called minimums and reported that the airport was in sight, and the pilots landed without incident. The pilot estimated that the ceiling was "right at minimums" (1,320 feet msl) and the visibility was about 5 to 6 miles.

[41] The Safety Board's airplane performance study indicated that the airplane was about 1.9 nm (about 2.2 sm) from the end of the runway when it descended through the MDA and between 1.6 and 1.7 nm (about 1.85 to 1.95 sm) from the end of the runway when the pilots stated that the approach lights were in sight.

[42] IFR weather conditions are defined as a ceiling of less than 1,000 feet agl and/or visibility less than 3 sm.

[43] MVFR weather conditions are defined as a ceiling between 1,000 and 3,000 feet agl, inclusive, and/or visibilities from 3 to 5 miles, inclusive.

The Safety Board also received written and verbal statements from a charter pilot who was on the ground waiting to depart when the accident occurred. He estimated that the weather conditions at the time of the accident were overcast clouds about 300 feet agl and visibility about 3 to 4 miles.

1.7.3 Predeparture Weather Information Obtained by the Pilots

Corporate Airlines dispatch personnel provided the pilots with a weather synopsis, reported and forecast weather conditions for the route of flight, destination, and two alternate airports (STL and UIN),[44] notices to airmen, and an IRK field condition report. Additionally, Corporate Airlines obtains pertinent forecasts from Meteorlogix, a contract weather information provider. The Meteorlogix forecast for IRK that the pilots received predicted winds from 040° at 5 knots, visibility between 2 and 4 sm in mist, and an overcast ceiling at 800 feet agl around the time of the accident.

Corporate Airlines dispatch personnel in STL had access to air-to-ground radio communication with the accident flight, if needed, to provide the flight crew with weather updates or other information. However, the dispatcher on duty in STL reported that, on the day of the accident, she had no postdeparture communications with the flight crew.

1.8 Aids to Navigation

No difficulties with the navigational aids were known or reported.

1.9 Communications

No communications problems were reported between the pilots and any of the air traffic controllers who handled the flight.

1.10 Airport Information

IRK is located about 6 miles southeast of Kirksville, Missouri. The official airport elevation is 966 feet. The primary runway at IRK, runway 18/36, is concrete, 6,005 feet long, and 100 feet wide. At the time of the accident, runway 36 was equipped with medium-intensity runway lights, a medium-intensity approach lighting system, and VASI lights located on the left side of the runway.

The localizer DME approach to runway 36 at IRK is categorized as nonprecision because it does not include electronic vertical glidepath guidance. The approach procedure requires airplanes to pass over the FAF, an outer marker that is located 5.2 DME miles

[44] According to Federal regulations (14 CFR 121.619), two alternate airports are required anytime the forecast weather conditions for the destination and first alternate airport indicate ceilings less than 2,000 feet above the airport elevation and/or visibilities less than 3 miles within an hour of the estimated time of arrival.

south of the airport. After the airplane passes the FAF, pilots can descend to the MDA of 1,320 feet msl, which is 356 feet above the runway touchdown elevation. Pilots can not descend beneath the MDA unless they can see the runway environment, in which case, they are allowed to descend to 100 feet above the TDZE (964 feet) and continue the approach until they can see the runway itself. If the pilots do not see the runway environment or the runway by the time they reach the missed approach point (MAP, near the approach end of runway 36), they are required to perform a missed approach. (Figure 4 is an approach chart for the localizer DME approach to runway 36 at IRK.)

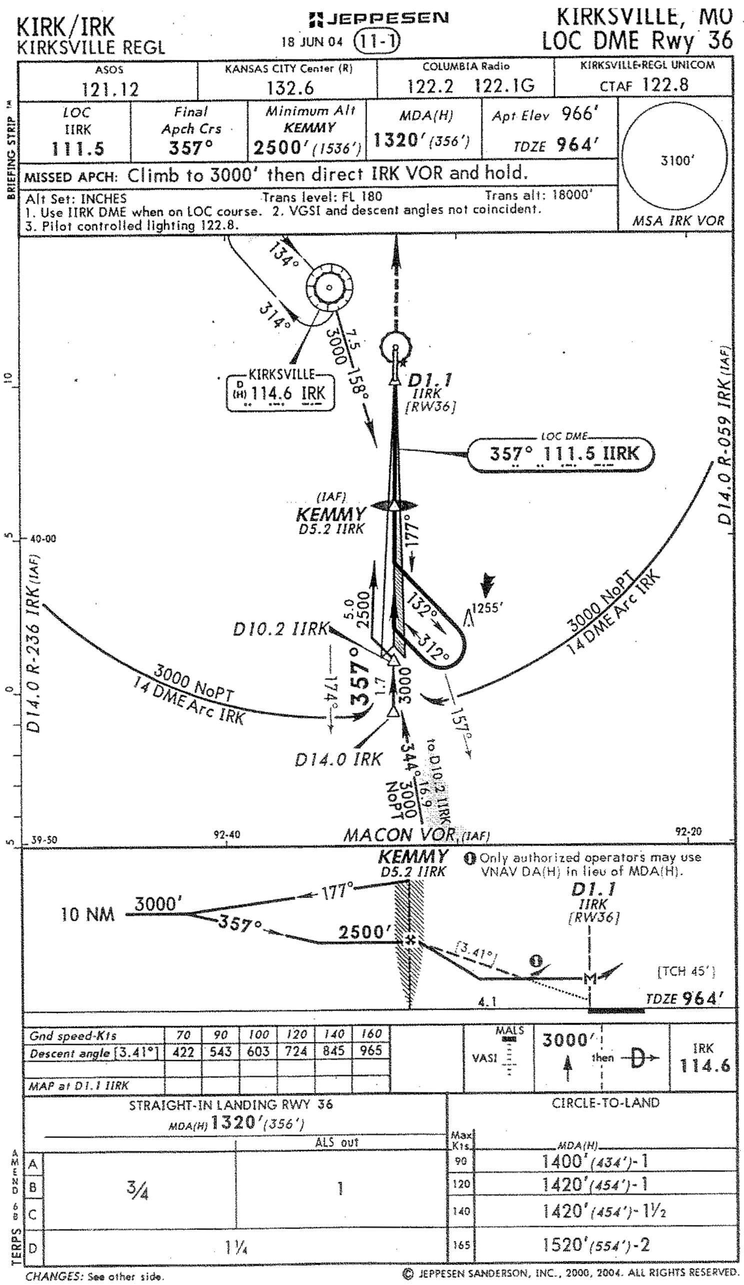

Figure 4. An approach chart depicting the localizer DME approach to runway 36 at IRK.

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder

The CVR installed on the accident airplane was an L-3 Communications/Fairchild model A-100A, S/N 55843, magnetic tape CVR. The exterior of the CVR showed significant structural damage; however, the interior of the recorder and the tape showed no apparent heat or impact damage and the tape was successfully played back. The CVR recording consisted of four channels of good quality[45] audio information: one channel contained audio information recorded by the cockpit area microphone (CAM), two other channels contained audio information recorded through the radio/intercom audio panels at the captain and first officer positions, and the fourth channel was not used (nor was its usage required) on this recording.

The recording began about 1906:46 and ended about 1936:58, after it recorded the sounds of numerous impacts. A transcript was prepared of the entire 30-minute, 12-second recording. See appendix B for a complete transcript of the CVR recording.

1.11.2 Flight Data Recorder

The FDR was an L-3 Communications/Fairchild Model F1000, S/N 00511, that recorded six parameters of airplane flight information (time, altitude, airspeed, vertical acceleration, magnetic heading, and radio transmissions/keying) in a digital format using solid-state flash memory. The outer sleeve of the FDR showed evidence of thermal damage, but the recorder was otherwise in good condition, and more than 130 hours of data were successfully downloaded. The accident flight was the last flight on the recording and its duration was about 41 minutes. The CVR and FDR times were correlated based on their one commonality—the microphone key times are recorded by the FDR and the sounds associated with keying the microphone are recorded by the CVR.

1.11.2.1 Flight Data Recorder Parameter Requirements/Information

In response to numerous Safety Board recommendations, the FAA has issued a series of rule changes regarding FDR requirements since 1987, which gradually increased the number of required recorded parameters from six to the current requirement of 88 (for newly manufactured aircraft). In particular, 14 CFR 121.344a requires most turbine-engine-powered airplanes that seat from 10 to 19 passengers to be equipped with FDRs that record a minimum of 18 parameters. However, this regulations applies only to airplanes entered on the U.S. registry after October 11, 1991; airplanes entered on the U.S. registry before this date are not required to be equipped with an FDR. In addition, an exception to 14 CFR 121.344a allows some airplanes, including the BAE-J3201, to operate under Part 121 with FDRs that record fewer parameters (the accident airplane's FDR recorded six parameters). These airplanes are listed in paragraph (f) of the

[45] The Safety Board rates the quality of CVR recordings according to a five-category scale: excellent, good, fair, poor, and unusable. See appendix B for a description of these ratings.

regulation. According to the FAA's FDR rule change, issued on July 17, 1997,[46] exceptions to the rule were made because the cost of re-certifying and retrofitting[47] airplanes that were not originally designed to record the additional parameters outweighed the benefit of additional recorded data for select airplane models. Currently, the FAA registry shows more than 500 airplanes that are exceptions to 14 CFR 121.344a; about 40 percent of these airplanes are BAE-J3201, BAE-J3101, and Beech 1900 airplanes, which are involved in Part 121 passenger-carrying operations.

The Safety Board notes that new technology—specifically, onboard image recorders[48]—could provide supplemental parametric information on airplanes that are operating either without FDRs or with FDRs recording a limited number of parameters. The use of image recorders would not require extensive modifications to the airplane during installation, and thus could be installed at a more reasonable cost than upgraded FDRs. Image recorders would also provide additional information not readily available from the CVR and/or FDR, such as the environment within the cockpit and outside the cockpit window and the manipulation of controls and switches in the cockpit. In April 2000, the Safety Board issued Safety Recommendation A-00-30, which asked the FAA to do the following:

> Require that all aircraft operated under Title 14 CFR Part 121, 125, or 135 and currently required to be equipped with a CVR and digital flight data recorder (DFDR) be retrofitted…with a crash-protected cockpit image recording system. The cockpit image recorder system should have a 2-hour recording duration, as a minimum, and be capable of recording, in color, a view of the entire cockpit including each control position and each action (such as display selections or system activations) taken by people in the cockpit. The recording of these video images should be at a frame rate and resolution sufficient for capturing such actions. The cockpit image recorder should be mounted in the aft portion of the aircraft for maximum survivability and should be equipped with an independent auxiliary power supply that automatically engages and provides 10 minutes of operation whenever aircraft power to the cockpit image recorder and associated cockpit camera system ceases, either by normal shutdown or by a loss of power to the bus. The circuit breaker for the cockpit image recorder system, as well as the circuit breakers for the CVR and the DFDR, should not be accessible to the flight crew during flight. (A-00-30)

Additionally, on December 22, 2003, the Safety Board issued Safety Recommendation A-03-65, asking the FAA to do the following:

[46] See the *Federal Register* (FR), 62 FR 38362.

[47] FDR modifications required for retrofit include adding sensors at and wiring to each of the control surfaces, actuators, and/or other components being added as parameters.

[48] Image recorders obtain audio information (similar to that recorded by CVRs), provide an alternate means of discovering event data that is often recorded by FDRs, and record information about the environment within the cockpit and outside the cockpit window.

> Require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with a [FDR], and that are operating under 14 *Code of Federal Regulations* Parts 135 and 121 or that are being used full-time or part-time for commercial or corporate purposes under Part 91 to be retrofitted with a crash-protected image recording system by January 1, 2010. (A-03-65)

In a March 29, 2004, letter to the Safety Board, the FAA stated that safety recommendations regarding CVRs, FDRs, and image recorders "are uniquely difficult for the FAA to respond to in a manner that the Safety Board finds acceptable." The FAA also stated that recorder recommendations presented unique challenges, including difficulties in cost/benefit analysis, technical hurdles, retrofit problems, data use issues, and privacy concerns.

On June 3, 2004, staff from the FAA and the Safety Board met to discuss in general the FAA's response to CVR, FDR, and image recorder recommendations. On December 15, 2004, the Board wrote to the FAA stating that, although the meeting was constructive, the substance of previously issued safety recommendations was not discussed. Because the FAA had not advised the Board of any actions to address the previously mentioned safety recommendations, the Board classified them "Open—Unacceptable Response."

On February 22, 2005, the FAA issued a notice of proposed rulemaking (NPRM) titled, "Revisions to Cockpit Voice Recorder and Digital Flight Data Recorder Regulations," which did not address image recorders. In an April 29, 2005, response to this NPRM, the Safety Board stated that it was disappointed about this omission. The Board also stated that image recorders would have provided in-depth information about the facts, conditions, and circumstances surrounding numerous accidents. The Board restated its opinion that image recorders could play a key role in accident investigations by providing critical human performance and cockpit environment information that would be otherwise unavailable. The Board encouraged the FAA to move quickly to implement the image recorder recommendations.

In an October 11, 2005, letter to the Safety Board, the FAA stated that it conducted simulator and flight tests in June 2005 to address issues regarding what to record and whether an image recorder would be sufficient to record parametric data. The FAA indicated that the results of these tests would be available in a final report, which the FAA anticipated would be completed by December 2005. On January 26, 2006, the FAA published a proposed image recorder technical standard order (TSO-C176) for a crash-protective video recording system. Public comments are due by February 27, 2006.

1.12 Wreckage Information

The first evidence of impact (damage to two trees located near the top of a slight ridge) was observed about 1.3 miles south of the approach end of runway 36. The airplane first impacted trees about 50 feet above the ground (about 996 feet msl), and a swath of broken trees continued in a northerly direction to the main wreckage area, about 775 feet north of the initial impact. Many of the broken trees that were near the main wreckage area exhibited moderate charring and burning.

The main wreckage (which included the remains of the fuselage and the empennage, the right wing, the inboard portion of the left wing, and the remains of the right engine and propeller and the left propeller) was located in an almost circular area about 30 feet in diameter and exhibited extensive fire damage. Most of the main wreckage and the surrounding vegetation were consumed by fire. Figure 5 is a photograph of the main wreckage area.

Figure 5. Photograph of the main wreckage area.

The forward section of the airplane is in the foreground, and the tail section is in the background (the aft pressure bulkhead is indicated by the red arrow).

The identifiable remnants of the forward fuselage included the forward instrument panel and associated wiring bundles and some small pieces of the lower forward fuselage structure. The flight instruments on the captain's side of the instrument panel and most of the center instrument panel were almost completely destroyed by fire. Many of the flight instruments on the first officer's side of the instrument panel exhibited impact, fire, and/or smoke damage. The first officer's altimeter was retained for further examination. Subsequent examination and disassembly revealed that the altimeter was capable of normal operation at the time of impact and that the barometric setting was between 29.95 and 29.96 inches Hg. The landing gear selector was found loose and the surface features had been consumed by fire; the internal mechanism was in the gear-down position.

The center fuselage structure was largely consumed by fire, and no evidence of the over-wing exits was found. A portion of the aft fuselage was found relatively intact and on its left side; the remainder was consumed by fire. The main cabin door, which was located on the left side of the aft fuselage, was found in the closed and latched position with some fire damage to the interior. The lower half of the vertical stabilizer, the lower third of the rudder, and the left horizontal stabilizer and elevator remained attached to the aft fuselage. The top half of the vertical stabilizer was located between two trees at the northern edge of the main wreckage site, and the top two-thirds of the rudder was located in pieces about 70 feet north of the main wreckage site. The right horizontal stabilizer and elevator were not attached to the aft fuselage; however, portions of these assemblies were located in the main wreckage site near the upper portion of the vertical stabilizer.

The left wing was broken into three major pieces. The outboard portion of the left wing was located about 15 feet above the ground in a tree located about 530 feet from the initial point of impact, with other wing debris located between the initial impact point and the outboard wing section. The leading edge of the outboard portion of the left wing exhibited significant impact damage, including four distinct, semicircular impact marks. No fire damage was evident on the outboard portion of the left wing or along the wreckage path leading to the point where the outboard portion of the left wing was found. The middle portion of the left wing was found among branches and other tree debris, all of which exhibited substantial fire damage. The inboard portion of the left wing was located at the main wreckage site and exhibited extensive fire damage. The left main landing gear remained attached to this portion of the wing, and its actuator was in the extended position.

The right wing was found in two sections, both of which were located at the main wreckage site. Most of the inboard portion of the right wing had been consumed by fire; however, small, unmelted portions of the right wing forward and rear spars and the right wing inboard and outboard flaps were found at the main wreckage site. The outboard portion of the right wing was located at the main wreckage site at the edge of an area of intense fire damage and exhibited light-to-moderate fire damage. The leading edge of the outboard portion of the right wing exhibited semicircular impact damage similar to that seen on the outboard portion of the left wing. The right main landing gear remained attached to the inboard portion of the wing, and its actuator was in the extended position.

The left engine was located about 30 feet northwest of the main wreckage site and was largely intact with no fire damage. The right engine was located amidst the inboard right wing wreckage at the main wreckage site and exhibited extensive fire damage. Postaccident examination and teardown of the engines and their components revealed no evidence of preexisting defects or anomalies that would have prevented normal engine operation. Both engines exhibited rotational damage through the compressor and turbine sections and metal spray on static and rotating parts of the turbine sections.

The left and right propeller assemblies had separated from their respective engines and were located at the main wreckage site. Postaccident examination and teardown of the propeller assemblies revealed no evidence of preexisting defects or anomalies that would have prevented normal propeller operation. All eight propeller blades exhibited bends, twists, and/or curls that were consistent with rotation at the time of impact.

1.13 Medical and Pathological Information

The chief medical examiner from Sedgwick County, Kansas, with assistance from other Disaster Mortuary Operational Response Team (DMORT)[49] personnel, performed autopsies and toxicology tests on the fatally injured pilots and passengers. The blood specimens collected from the captain and first officer tested negative for ethanol and a wide range of drugs, including drugs of abuse.[50] Subsequent toxicological tests were performed by the FAA Civil Aeromedical Institute (CAMI); a urine specimen collected from the captain tested positive for acetaminophen (101.6 ug/ml);[51] blood and liver specimens obtained from the first officer revealed an unspecified quantity of quinine.[52]

1.14 Fire/Explosion

A postimpact fire destroyed most of the airplane.

1.15 Survival Aspects

Autopsy and toxicological results indicated that the cause of death for the 13 fatally injured passengers was "multiple blunt force injuries" resulting from the impact. The two survivors had serious injuries, including fractures and lacerations. The surviving passengers occupied seats 4A and 4C,[53] which were located over the main wing spar and near the emergency exits. (No one was seated in seat 4B.) During postaccident interviews, the survivors reported that they exited the airplane through a break in the left side of the fuselage at the exit row and were able to move a safe distance away from the wreckage before the postimpact fire engulfed the airplane and surrounding trees.

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[49] DMORT services are arranged through an interagency agreement between the Safety Board and the Department of Homeland Security. Upon request, DMORT assists local medical examiners and coroners in victim identification and cause of death determinations.

[50] The drugs tested in the postaccident analysis include (but are not limited to) marijuana, cocaine, opiates, phencyclidine, amphetamines, benzodiazapines, barbiturates, antidepressants, antihistamines, meprobamate, and methaqualone.

[51] According to the captain's fiancée, the captain awoke with a headache on the day of the accident.

[52] Quinine is found in tonic water and is not quantified in CAMI results unless a substantial quantity is present.

[53] See figure 1, which is a diagram of the accident airplane's cabin and cockpit configuration, in section 1.6 of this report.

1.15.1 Emergency Response Information

IRK is an uncontrolled airport that operates in accordance with 14 CFR 139.209, "Limited Airport Operating Certificate: Airport Certification Specifications." Postaccident interviews indicated that the airport operator (whose duties included aircraft rescue and firefighting [ARFF] response, line service [fueling, cleaning, towing, deicing of airplanes], weather observation augmentation, and general airport and customer services) was on duty at the airport when the accident occurred. He stated that he was performing routine duties in the office and listening to the local Kansas City ARTCC frequency on the radio monitor in anticipation of the arrival of the accident flight. He stated that when he heard the ARTCC controller clear the accident flight for the approach, he walked outside to watch for the airplane descending through the clouds. When the flight did not arrive, the airport operator returned to the office and changed to the IRK CTAF to listen for communication from the accident flight. He stated that when he heard nothing on that frequency, he changed back to the local ARTCC frequency; he heard nothing for a few minutes and then heard ARTCC trying to make radio contact with the accident flight.[54]

The airport operator stated that he subsequently received a telephone call from a local farmer who advised him that an airplane had crashed south of the airport. About 1953, after obtaining a more detailed description of the accident location, the airport operator telephoned Kirksville 911 dispatch to report the accident. According to the Kirksville 911 dispatch timeline, between 1955 and 2003, the dispatcher initiated emergency response regarding the accident, including contacting the Macon County 911 Center, LaPlata Fire Department (LPFD), AirEvac, Southwest Rural Fire Department, Kirksville Police Department, Adair County Sheriff Department, and Adair County Ambulance Dispatch. In addition, a Missouri State Highway Patrol trooper was at the Macon County 911 Center when the notification telephone call was taken, and he responded to the accident site. The Kirksville 911 dispatch timeline indicated that first responders from LPFD reached the accident site about 2020.

1.15.1.1 Emergency Response Personnel Statements

According to postaccident interviews with the LPFD incident commander (IC) for the accident response, he was contacted about 2000 and advised to standby for information regarding a possible missing airplane. About 3 minutes later, Kirksville 911 dispatch personnel directed LPFD personnel to an airplane accident south of IRK. The IC stated that he and his colleagues were en route by about 2006 and were the first responders to reach the accident site about 2020. He reported that the airplane was located in a wooded area between farmed fields and was burning when they arrived. He indicated that the responders split into teams to start searching for survivors. As

[54] According to ATC records, the ARTCC controller tried to contact the accident flight repeatedly (about 1943:37, 1951:48, 1959:50, and 2008:41). In between these calls (about 1954:44) the ARTCC controller determined that the pilots had not canceled their IFR clearance with the Columbia, Missouri, Flight Service Station (FSS). Records indicate that the airport operator contacted the FSS about 2000:59 to report an airplane accident south of IRK.

responders from other jurisdictions arrived at the accident site, the LPFD responders located the two survivors and helped them to the Adair County ambulance.

According to the IC and several LPFD firefighters, maintaining control of the site became a challenge as law enforcement personnel from multiple jurisdictions arrived at the accident site.[55] LPFD and other firefighting and emergency medical services personnel had difficulty communicating with some law enforcement personnel because of the use of different radio frequencies and traffic congestion near the accident site. According to an LPFD firefighter, the traffic congestion created a situation in which the Adair County ambulance could not immediately exit the area until law enforcement vehicles from multiple jurisdictions were moved. The Adair County ambulance dispatch nurse/emergency medical technician stated that she did not believe that the movement of the other vehicles delayed the ambulance's departure because she was working to stabilize the survivors while those vehicles were moved.

1.15.1.2 Postaccident Emergency Response Actions

On November 30, 2004, the Adair County Local Emergency Planning Committee (LEPC) organized a meeting with representatives of the agencies that responded to the accident to evaluate the emergency response. Meeting participants identified several areas that needed improvement, including communications and coordination at the accident scene and additional training specific to aircraft accident response and emergency response management techniques. The LEPC formed a committee to address these issues.

Subsequently, the city of Kirksville acquired a mobile command vehicle for use at incident and accident sites and LaPlata and Kirksville Fire Department personnel attended a 2-day aircraft accident response course presented by the University of Missouri and a 6-hour IC training course at IRK on the use of the new mobile command vehicle during emergency responses. In addition, personnel from the LPFD, Kirksville Fire Department, Sheriff's Department, 911 Dispatch, and some Missouri State Highway Patrol completed the National Incident Management System (NIMS) training course.[56] Further, the chairman of the LEPC advised the Safety Board that the Adair and Macon County emergency response agencies are currently working to establish a common command frequency system to be used by all responding agencies at accidents or incidents within their jurisdictions.

[55] According to the Adair County emergency medical technician who drove the truck and arrived at the accident site about 2025, he saw between 50 and 75 vehicles parked along the road with more arriving and a "mass cluster of…people."

[56] NIMS is a nationwide training course developed by the Department of Homeland Security in July 2004 to provide fire and rescue personnel with comprehensive and standardized information regarding incident command and emergency response management techniques.

1.16 Tests and Research

1.16.1 Airplane Performance Study

Safety Board investigators used available data from the accident airplane's FDR and CVR, radar data from IRK Air Route Surveillance Radar, atmospheric data from the IRK ASOS, and physical evidence from the accident scene to calculate the airplane's flightpath, angle of attack, and power settings during the airplane's descent on the accident approach. The Board's study indicated that the airplane did not appear to deviate in flightpath angle or heading until just before it impacted the first set of trees at an altitude of about 996 feet msl. Further, the study indicated that the airplane was in a steady descent with minimal engine power settings before the initial tree strike. Figure 6 shows the airplane's altitude profile during the accident approach with the airport/runway location shown. Figure 7 shows the airplane's altitude profile during the accident approach with CVR comments overlaid.

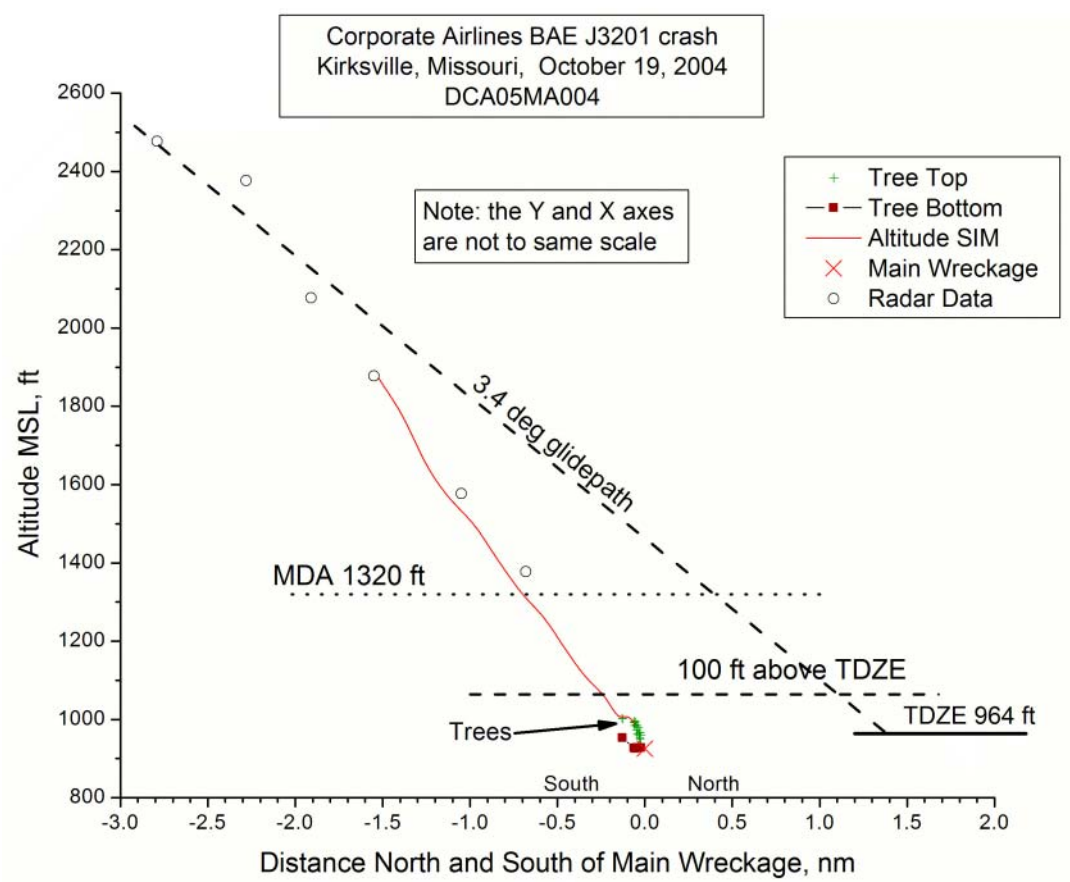

Figure 6. The accident airplane's descent profile during the accident approach with the airport/runway location shown.

The following altitudes are also shown: MDA, 100 feet above the TDZE, and the TDZE. Additionally, a 3.4° visual glidepath to the airport is shown for reference purposes only.

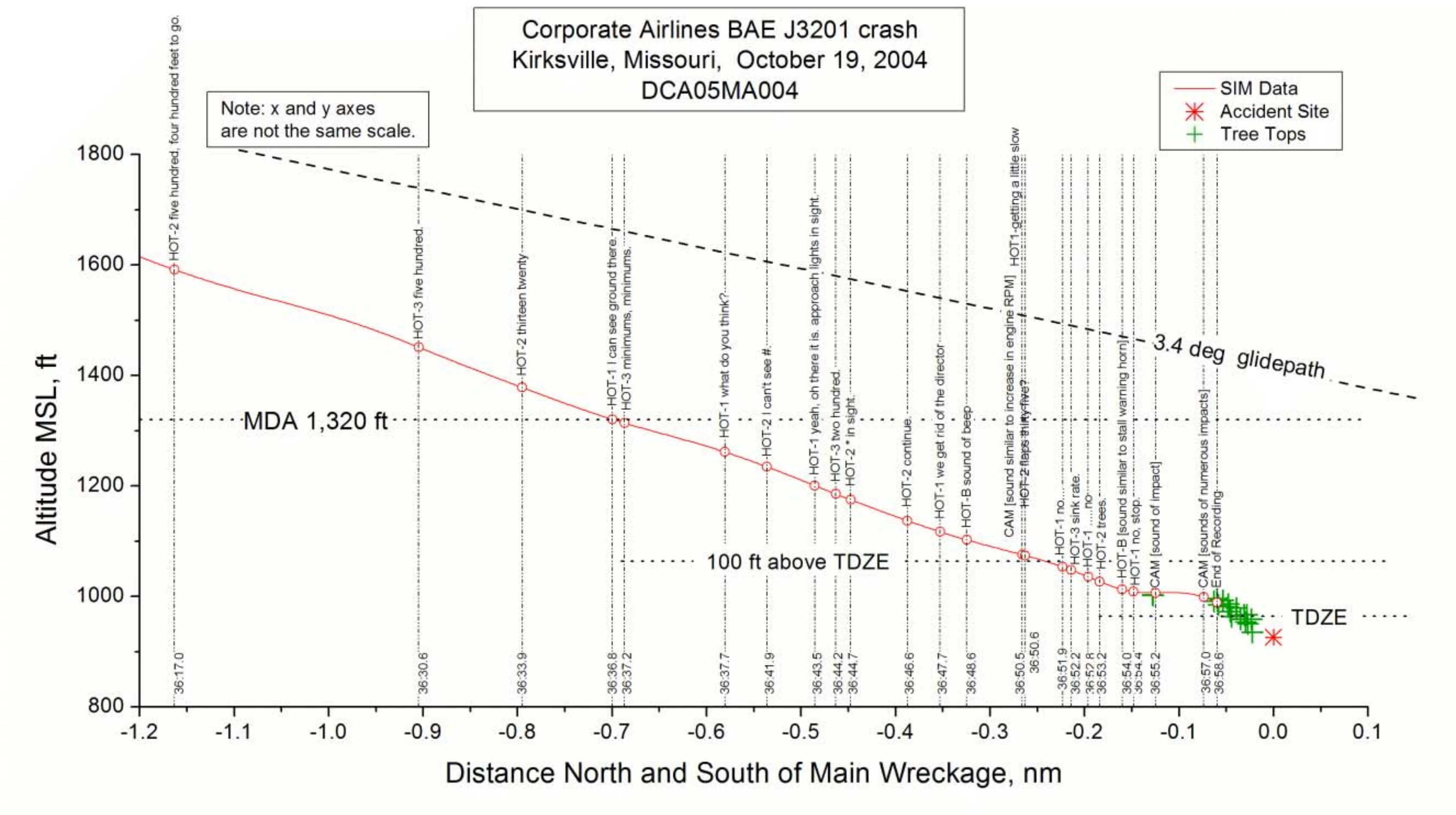

Figure 7. The accident airplane's descent profile during the accident approach with CVR comments overlaid.

The following altitudes are shown: MDA, 100 feet above the TDZE, and the TDZE. Additionally, a 3.4º visual glidepath to the airport is shown for reference purposes only.

1.16.2 Ground Proximity Warning System Evaluation

The Safety Board evaluated the GPWS equipment on board the airplane and compared it with the enhanced GPWS (EGPWS)[57] technology that was available at the time of the accident. The Board's evaluation indicated that the GPWS installed on the airplane operated as designed and provided a "sink rate" warning when the airplane descended through about 1,050 feet msl (about 104 feet agl) and entered the GPWS outer warning boundary about 2 to 3 seconds before the CVR recorded the first sounds of impact. The Board's evaluation further indicated that if the airplane had been equipped with currently available EGPWS technology, the pilots would have received a "too low terrain" warning when the airplane descended below the EGPWS runway field clearance floor for that area about 10 seconds before impact.

Federal regulations (specifically, 14 CFR Part 121.354, 135.154, and 91.223) required that all turbine engine powered airplanes operating under Part 121 be equipped with terrain awareness and warning systems (TAWS) or EGPWS[58] by March 29, 2005 (about 5 months after the accident). According to Corporate Airlines personnel, the company had scheduled its BAE-J3201 fleet for EGPWS installation as part of its regular maintenance program. At the time of the accident the company had installed EGPWS on 2 of the company's 12 operating BAE-J3201 airplanes and the remainder were installed before the FAA's March 2005 deadline.

1.17 Operational and Management Information

When Corporate Airlines (now known as RegionsAir), began operations in December 1996, it was a privately held Part 121 air carrier headquartered in Smyrna, Tennessee. At the time of the accident, Corporate Airlines was doing business as American Connection under an agreement with American Airlines and based its flight operations out of STL and Nashville International Airport in Nashville, Tennessee. At that time, the company operated 12 BAE-J3201 airplanes, employed 65 pilots and 5 dispatchers, and provided service to 14 cities.

1.17.1 Corporate Airlines Policies/Procedures/Training

1.17.1.1 Training Information—General

Corporate Airlines' initial pilot training program included 3 weeks of ground school, flight training in a simulator and in an airplane. The pilots then received initial operating experience in an airplane. The ground school portion included training and testing in the following: basic company indoctrination; airplane performance; weight and

[57] EGPWS provides an aural ground proximity warning based on a comparison of the airplane's location to an on-board terrain map rather than the radio-altitude information used by a GPWS.

[58] The FAA uses the term TAWS to refer to systems, including EGPWS, that meet the standards of AD 2004-08-15.

balance; checklist philosophy; crew resource management (CRM);[59] stabilized, precision, and nonprecision approaches; CFIT;[60] cockpit flows and instrument panel scans (practiced in a cockpit procedures trainer); and airplane systems (1 week of sessions). Corporate Airlines representatives indicated that they did not provide (nor were they required to provide) company pilots with formal fatigue-related training.

Eighty-five percent of a new pilot's flight training would take place in the simulator (usually during about five simulator sessions), and the remainder of the flight training would occur in an airplane (usually during two night sessions). Upon completion of flight training, a pilot-trainee's initial operating experience would typically consist of a trip sequence (about 20 hours) with a Corporate Airlines check airman.

Postaccident interviews indicated that company pilots described the training as challenging and intense;[61] according to the director of training, some of the company's initial training classes had up to a 25 percent failure rate. He stated that he encouraged new-hires to familiarize themselves with the airplane information available on the company's Web site before they reported for training.

1.17.1.2 Non-Precision Approach/Missed Approach Guidance

Corporate Airlines' BAE-J3201 aircraft manual stated the following:[62]

> If the missed approach point is reached without establishing visual contact, a missed approach must be initiated.
>
> In the event that visual contact is made with the runway, the nonflying pilot will call, "runway in sight" and will continue to make the appropriate altitude callouts, referenced to airport elevation.
>
> Upon hearing the "runway in sight" call by the nonflying pilot, the flying pilot will transition to visual cues outside the cockpit, and upon seeing the runway/airport will state, "going visual, leaving minimums, flaps 35 degrees."

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[59] Corporate Airlines' CRM training involved a 6-hour session that complied with existing FAA regulations and addressed CRM concepts and policies of cockpit responsibility and duties during flight. During postaccident interviews, several Corporate Airlines pilots and check airmen stated that the company's CRM training was good and effective.

[60] Corporate Airlines' CFIT training was provided to pilots during initial and recurrent training. It consisted of an FAA-produced presentation on CFIT, supplemented by a videotape and instruction from/classroom discussion with the assistant chief pilot on CFIT/CRM issues that included references to CVR transcripts from recent accidents. Pilots were given a handout of CFIT information and were tested on the CFIT information.

[61] According to the captain's fiancée, the captain stated that Corporate Airlines training personnel taught the material well, and he learned what he needed to know. According to his mother and a pilot friend, the first officer indicated that the training was difficult and very intensive; he told her that quite a few pilots had dropped out of his training class.

[62] Postaccident interviews indicated that Corporate Airlines' nonprecision-approach-related training was consistent with this guidance.

> Upon reaching the missed approach point, if the nonflying pilot has not stated "runway in sight" or if transition to visual cues is not possible, or if the aircraft is not in position for a normal landing, the flying pilot will initiate a missed approach by stating, "missed approach."

According to Corporate Airlines' BAE-J3201 flight manual, nonprecision instrument approach and landing callout procedures required the nonflying pilot to announce when the localizer indicator became active on the flight instruments,[63] to provide the flying pilot with directional information as needed upon sighting the runway, and to announce when the airplane descended below the MDA. In addition, Corporate Airlines' procedures required the nonflying pilot to make a "100 feet above minimums" callout when the airplane was 100 feet above the MDA and then to callout "minimums" when the airplane reached the MDA during a nonprecision approach.[64] According to the Corporate Airlines BAE-J3201 systems manual, the airplane's GPWS makes callouts at 500 feet agl, the MDA (based on the radio altimeter setting), and 200 feet agl during nonprecision approaches to assist pilots in maintaining situational awareness.[65]

According to the Corporate Airlines BAE-J3201 aircraft manual, if the nonflying pilot established visual contact with the runway environment after the MDA was reached, that pilot would call, "approach lights in sight, continue."[66] At that point Federal regulations would allow the flying pilot to continue the descent beyond the MDA to 100 feet above the TDZE. According to 14 Part 121.651(c)(3), pilots are permitted to descend below the MDA to 100 feet above the TDZE[67] if at least one of the following items is "distinctly visible and identifiable" to them: any portion of the approach lighting system; VASI lights; runway end identification lights; the runway threshold, threshold markings, or threshold lights; runway lights; touchdown zone lights; the touchdown zone or touchdown zone markings; and/or the runway or runway markings. If none of these items/visual aids are "distinctly visible and identifiable," Corporate Airlines' BAE-J3201 flight manual, section 7, Approach and Landing, pages 14 and 15, stated that pilots must perform a missed approach when they reach the MAP.

Corporate Airlines' BAE-J3201 flight manual, section 7, Approach and Landing, pages 8 and 9, also stated that an immediate missed approach is mandatory if an approach becomes unstabilized while operating in IMC. The manual stated that 900 fpm was the maximum rate of descent for a stabilized approach between 300 feet agl and 50 feet agl. Further, in Corporate Airlines' flight manual, phase 2 of the stabilized approach procedure allows a 1,200 fpm descent rate from 1,000 feet agl down to 300 feet agl. Current FAA

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[63] About 1931:38, the CVR recorded the first officer stating that the localizer course was alive.

[64] CVR evidence indicates that the first officer did not make the required "100 above minimums" or "minimums" callouts. However, shortly after the GPWS annunciated 500 feet agl, as the airplane descended through about 1,360 feet msl, the first officer stated "thirteen twenty." (The MDA was 1,320 feet msl.)

[65] The CVR's CAM recorded all of the required GPWS callouts during the accident approach.

[66] About 1936:48, as the airplane descended through about 1,160 feet msl (160 feet below the MDA), the CVR recorded the first officer stating, "…in sight…continue."

[67] Descent below this altitude is not permitted unless the approach lighting system's red terminating bars or the red side row bars are visible.

guidance (as stated in AC 120-71A Standard Operating Procedures for Flight Deck Crewmembers) states that one of the criteria for a stabilized approach is a descent rate no greater than 1,000 fpm below 1,000 feet agl.

FAA Order 826.3B states that published nonprecision instrument approach procedures ensure obstacle clearance down to the MDA but obstacle clearance is not ensured below the MDA. When the nonflying pilot announced, "runway in sight," the flying pilot was to transition from cockpit instruments to external visual cues, and, upon seeing the runway, was to state "going visual, leaving minimums, flaps 35 degrees."[68]

1.17.1.3 Crew Schedule Information

During postaccident interviews, Corporate Airlines' director of operations (former chief pilot) told investigators that it was difficult to maintain a pilot-staffing level sufficient to crew the company's scheduled flights. He stated that the company flight schedules were legal but that it was a challenge to balance what pilots wanted and what the company needed. The director of operations stated that the pilots who commuted to their duty station typically wanted as much flight time as possible per duty day so they could complete their assigned flight hours efficiently and maximize their time off; they did not like "down time sitting around." For example, he indicated that pilots would be pleased if he assigned them 7 or more hours of flight time per day with 3 duty days per week, rather than fewer hours per day with more duty days.

Several Corporate Airlines managers and pilots who were interviewed during this investigation commented that the long days scheduled by the company could be tiring, especially when ceilings and visibilities were low throughout the region. One Corporate Airlines captain/check airman stated that he thought pilots complained about the scheduled flight and duty times when their workload increased during periods of bad weather. He also stated that the lack of an autopilot could increase crew fatigue especially when operating in adverse weather.

According to several current and former Corporate Airlines employees (including the chief pilot at the time of the accident,[69] several line check airmen, and line pilots), the company did not pressure pilots to fly if they felt fatigued. Interviewees indicated that there would be no adverse ramifications if a pilot declined a trip because he/she was fatigued. The chief pilot at the time of the accident stated that he never questioned pilots who removed themselves from the schedule because of fatigue; however, he stated that it rarely occurred. According to Corporate Airlines' Director of Safety at the time of the accident, examination of the company database of pilot-reported and other safety issues revealed no reports of fatigue.[70]

[68] The CVR did not record the captain making this or any similar callout.

[69] The chief pilot at the time of the accident became director of operations in December 2004.

[70] Corporate Airlines provided a forum for employees to report safety issues and maintained a database for tracking safety issues.

The FAA's principal operations inspector (POI) for Corporate Airlines acknowledged that the schedule that the accident pilots flew on the day of the accident involved a lengthy duty day that started early in the morning after a limited rest period and that the schedule was demanding. However, he indicated that Corporate Airlines' schedules met Federal flight and duty time requirements. The Corporate Airlines POI also indicated that he had frequent discussions with Corporate Airlines managers and pilots about the company's management of crew duty time.[71] He stated that he typically got one telephone call a month from a Corporate Airlines pilot expressing concern about crew duty days. He stated that Corporate Airlines was short-staffed and tried to optimize its pilot scheduling to make use of the available pilots. Both the POI and assistant POI (APOI) stated that they did not believe that the company would pressure its pilots to fly if they felt sick or fatigued or otherwise unable to complete a scheduled flight.[72]

1.17.2 Federal Aviation Administration Oversight of Corporate Airlines

The FAA air carrier certificate for Corporate Airlines was overseen by the Nashville, Tennessee, flight standards district office. The POI at the time of the accident was the original certification project manager for review and approval of the Corporate Airlines operating certificate and had been the POI for the company since it began operations in December 1996. The APOI had been assigned to the Corporate Airlines certificate for about 1 1/2 years at the time of the accident.

Corporate Airlines' POI reported that, as a part of its operator surveillance, the FAA conducted an Office Special Inspection Program and a Regional Special Inspection Program of the company in 1998 and 1999, respectively. Both inspections identified only minor findings, mostly in the administrative and maintenance areas (for example, maintenance outsourcing; management of manuals and inspection records; completion of forms/documents/trip reports; dispatch and flight following; deicing program; and carriage of cargo). In 2001, the FAA changed its oversight/inspection program and began to conduct its surveillance of Corporate Airlines through the Surveillance and Evaluation Program (SEP) risk analysis and resolution tool.[73]

[71] The POI also stated that one of his greatest challenges was understanding and explaining the FAA's flight and duty times to operators. During the Safety Board's public hearing on the August 18, 1993, accident at Guantanamo Bay, Cuba, the manager of the FAA's Air Carrier Branch expressed concern "about the clarity and the possible ambiguity of" flight crew flight and duty time rules. For additional information, see National Transportation Safety Board, *Uncontrolled Collision With Terrain, American International Airways Flight 808, Douglas DC-8-61, N814CK, U.S. Naval Air Station, Guantanamo Bay, Cuba, August 18, 1993*, Aircraft Accident Report NTSB/AAR-94/04 (Washington, DC: NTSB, 1994).

[72] Neither the POI nor the APOI knew of any pilot declining a trip because they were fatigued. However, the POI told investigators that several pilots declined flights for emotional reasons during the days after the accident, with no repercussions from the company.

[73] According to Corporate Airlines' POI, the FAA's certificate management team uses the SEP to assess Corporate Airlines' areas of risk and the severity and likelihood of those risks, and to develop a plan for addressing those risks.

In an October 15, 2004, letter, the POI advised Corporate Airlines that the FAA intended to focus its surveillance efforts in the upcoming months on the following, in part: the company's deicing program (including training and equipment); maintenance task card completion; outsource maintenance vendors; and training for flight crews (because of pilot turnover and equipment changes) and maintenance and ground support personnel (because of changes to equipment and procedures). The POI told investigators that he was attentive in his surveillance of Corporate Airlines, specifically focusing on flight crew training/evaluation because the company, as an "entry-level" 14 CFR Part 121 airline, had a relatively junior pilot workforce and was often short-staffed.

1.18 Additional Information

1.18.1 Sterile Cockpit Information

During portions of the 30-minute, 12-second CVR recording, the pilots engaged in conversation that was not directly related to the conduct of the flight (see appendix B). For example, about 1910:13, the captain stated "gotta have fun" and criticized first officers he had flown with previously for being too serious.[74] About 1912:02, the captain transmitted a burp over the ARTCC radio frequency that would have been heard by other pilots and air traffic controllers. An unknown voice on the radio frequency responded to the captain's burp, stating, "nice tone," and the CVR recorded the accident pilots chuckling. About 1912:53, the captain talked about deliberately dropping a flight manual on a passenger whose foot had intruded into the cockpit. The first officer engaged in banter with the captain, and both pilots used informal, nonstandard terminology during the flight.

Although productive working relationships in the cockpit often involve nonessential conversation during relatively low workload periods (which is permitted by Federal regulations), research[75] indicates that crews that overemphasize social team cohesion may not perform as effectively as crews that focus on functional teamwork. Moreover, when the airplane is being operated in critical phases of flight, including the higher workload environment below 10,000 feet msl, the "sterile cockpit" rule (as stated in 14 CFR 121.542)[76] applies. This rule states the following, in part:

> No flight crewmember may engage in, nor may any pilot in command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his or her duties or which could interfere in any way with the proper conduct of those duties. Activities such as eating meals,

[74] Beginning about 1910:18, the CVR recorded the captain stating, "too many of these [expletive] take themselves way too serious, in this job. I hate it, I've flown with them and it sucks. A month of [expletive] agony…all you wanna do is strangle the [expletive] when you get on the ground."

[75] D. Druckman and J.A. Swets, *Enhancing Human Performance: Issues, Theories, and Techniques*, National Academy Press (1988): 159-163.

[76] Sterile cockpit rules for commuter and on-demand flight operations are addressed in 14 CFR 135.100.

> engaging in non-essential conversations within the cockpit and non-essential communications between cabin and cockpit crews, and reading publications not related to the proper conduct of the flight are not required for the safe operation of the aircraft.

At times, the pilots' conversation after the airplane descended below 10,000 feet msl (about 1921:24) was not consistent with these sterile cockpit procedures. For example, about 1922:17, the captain and first officer complained about passenger noise and the captain expressed a desire to make a public announcement telling the passengers to "shut the [expletive] up."

As the pilots neared the airport, prepared for, and initiated the approach, they generally adhered to operationally relevant communications; however, in many instances their communications were not wholly consistent with company-approved phraseology and involved nonessential communication. The Safety Board's review of FAA and Corporate Airlines records and postaccident interviews provided no evidence that either pilot habitually communicated or behaved in an unprofessional manner.

In January 1969, as the result of a December 24, 1968, accident involving an Allegheny Airlines Convair 580,[77] the Safety Board issued Safety Recommendation A-69-2, which recommended the following, in part, to the FAA:

> 1 Pilots, operators and regulatory agencies should renew emphasis on, and improve wherever possible, cockpit procedures, crew discipline and flight management.
>
> 2 Both the air carrier industry and the FAA should review policies, procedures, practices, and training toward increasing crew efficiency and reducing distractions and nonessential crew functions during the approach and landing phase of flight.
>
> 3 Crew functions not directly related to the approach and landing should be reduced or eliminated, especially during the last 1,000 feet of descent.
>
> 4 During the final approach, …pilot should maintain continuous vigilance of light instruments inside the cockpit until positive visual reference is established.

In February 1969, the FAA responded to these issues as follows:

> 1 The FAA reiterates their immediate concern and has initiated a program of follow-up action in the areas of procedures and cockpit discipline and vigilance.

[77] For additional information, see National Transportation Safety Board, *Allegheny Airlines, Inc., Convair 580, N5802, near the Bradford Regional Airport, Bradford, Pennsylvania, December 24, 1968*, Aircraft Accident Report NTSB, Bureau of Aviation Safety, PB189649 (Washington, DC: NTSB, 1969).

> 2 FAA inspectors have been directed to review, on a continuing basis, cockpit checklists and procedures to assure that minimum checking will be done during the more critical periods of flight, such as departures, approaches, and landings.
>
> 3 FAA believes the airlines require all cockpit check procedures to be completed well before the last 1,000 feet of descent. However, the FAA inspectors are to double check and take action where warranted.
>
> 4 FAA inspectors have been directed to assure that cockpit check procedures are arranged so that the pilot flying devotes full attention to flight instruments. In [a December 30, 1968] FAA wire to all U.S. airline presidents, FAA stressed crew vigilance and cockpit discipline.

On the basis of these FAA's actions, the Safety Board classified Safety Recommendation A-69-002, "Closed—Acceptable Action" on November 27, 1974.

As the result of a September 27, 1973, accident involving a Texas International Airlines Convair 600,[78] in which pilot professionalism was identified as an issue, the Safety Board issued Safety Recommendation A-74-86, which recommended the following, in part, to the FAA:

> Develop an air carrier pilot program, similar to the General Aviation Accident Prevention Program (FAA Order 8000.8A) that will emphasize the dangers of unprofessional performance in all phases of flight.

In an October 17, 1974, response, the FAA indicated that it agreed with this recommendation and that it would increase its participation in industry accident prevention seminars, hold meetings to discuss the subject, and urge FAA regional offices to emphasize professional performance. On the basis of the FAA's response and subsequent actions, on March 10, 1977, the Safety Board classified Safety Recommendation A-74-86, "Closed—Acceptable Action."

The Safety Board's investigation of a September 11, 1974, accident involving an Eastern Airlines DC9-31,[79] determined that the probable cause was, in part, "the flight crew's lack of altitude awareness at critical points during the approach due to poor cockpit discipline." The Board's report noted that the flight crew engaged in conversations on topics ranging from politics to used cars during the descent from cruise altitude. The Board concluded that "these conversations were distractive and reflected a casual mood

[78] For additional information, see National Transportation Safety Board, *Texas International Airlines, Inc., Convair 600, N94230, Mena, Arkansas, September 27, 1973*, Aircraft Accident Report NTSB/AAR-74-4 (Washington, DC: NTSB, 1974). In its recommendations related to this report, the Safety Board cited several other airline accidents that involved pilot performance issues, the Board report numbers for which are as follows: NTSB/AAR-72/04; NTSB/AAR-72/20; NTSB/AAR-72/31; NTSB/AAR-73/17; and NTSB/AAR-74/03.

[79] For additional information, see National Transportation Safety Board, *Eastern Airlines, Inc., Douglas DC-9-31, N8984E, Charlotte, North Carolina, September 11, 1974*, Aircraft Accident Report NTSB/AAR-75-9 (Washington, DC: NTSB, 1975).

and lax cockpit atmosphere, which continued throughout the remainder of the approach and which contributed to the accident."

In response to accident and other industry evidence of pilot performance deficiencies, the FAA enacted the sterile cockpit rule in 1981.

1.18.2 Additional Flight Crew-Related Accident Information

In 1994, the Safety Board conducted a study of flight-crew-involved major accidents of U.S. air carriers[80] that found that more than 80 percent of the accidents studied occurred when the captain was the flying pilot and the first officer was the nonflying (monitoring) pilot.[81] (This finding is consistent with testimony at the Board's public hearing on the August 6, 1997, accident involving Korean Air flight 801,[82] which indicated that CFIT accidents are more likely to occur when the captain is the flying pilot.)[83] The Board's study found that a frequent factor in accidents involving pilot errors was the failure of first officers to challenge errors (especially tactical decision errors) made by a flying captain. In addition, the study noted, "a first officer may have difficulty both in deciding that the captain has made a faulty decision, and in choosing the correct time to question the decision."

1.18.3 Nonprecision Instrument Approaches

FDR and radar data and the Safety Board's airplane performance study revealed that the rate at which the airplane descended from the FAF to (and through) the MDA was rapid, relatively constant, and resulted in it reaching the MDA well before the MAP. This type of descent was consistent with the more traditional nonprecision approach technique that Corporate Airlines pilots were trained to use.

The Safety Board notes that some air carriers (including United Airlines) have adopted alternative approach techniques for nonprecision instrument approaches, such as the "constant angle of descent" technique. The constant angle of descent technique involves establishing and maintaining a constant descent angle at a moderate descent rate from the FAF to the MDA, reaching the MDA very near the MAP while meeting all crossing restrictions described on the nonprecision approach plate. This constant angle of

[80] For additional information, see National Transportation Safety Board, *A Review of Flightcrew-Involved Major Accidents of U.S. Carriers, 1978 through 1990*, Safety Study NTSB/SS-94/01 (Washington, DC: NTSB, 1994).

[81] Typically in U.S. air carrier operations, the captain and first officer alternate flying pilot duties on flight legs.

[82] The Safety Board's public hearing on this accident was held from March 24 to 26, 1998, in Honolulu, Hawaii.

[83] This testimony was provided by a British Airways Boeing 777 captain who was a member of the Flight Safety Foundation CFIT Awareness Task Force. For additional information, see National Transportation Safety Board, *Controlled Flight Into Terrain, Korean Air Flight 801, Boeing 747-300, HL7468, Nimitz Hill, Guam, August 6, 1997*, Aircraft Accident Report NTSB/AAR-00/01 (Washington, DC: NTSB, 2000).

descent may be established and maintained through use of vertical navigation equipment or solely by reference to published approach plate data.[84]

As a result of the Korean Air flight 801 accident investigation,[85] the Safety Board issued Safety Recommendation A-00-14, asking the FAA to do the following:

> Require, within 10 years, that all nonprecision approaches approved for air carrier use incorporate a constant angle of descent with vertical guidance from on-board navigation systems.

In a February 23, 2004, letter to the FAA, the Safety Board noted that at that time, the FAA had incorporated a constant angle of descent in about 90 percent of the nonprecision approaches at airports that serve air carriers and that the remaining airports were scheduled to have constant-angle-of-descent information added by September 2007. As a result of the FAA's actions, the Board classified Safety Recommendation A-00-14, "Closed—Acceptable Action."

Additionally, in numerous publications (including FAA-H-8083-3A Airplane Flying Handbook and Air Traffic Bulletin #2001-3), the FAA has endorsed the constant-angle-of-descent approach technique, stating that "…for a nonprecision approach…[constant-angle-of-descent procedures] facilitate stabilized approaches…. other procedures that require abnormally high descent rates inhibit a pilot's ability to descend toward the runway in a stabilized constant descent configuration." Further, in its "Approach and Landing Accident Reduction" Briefing Note #7.2 (August—November 2000), the Flight Safety Foundation (FSF) stated that a constant-angle-of-descent approach profile "provides a more stabilized flightpath, reduces pilot workload, and reduces the risk of error."

1.18.4 Flight and Duty Time Information

According to FAA regulations, a two-person flight crew engaged in scheduled, domestic operations (such as the accident flight crew) would be limited to 8 flight hours between required rest periods (see section 1.5). However, these regulations do not take into consideration the starting time of day, the length of the duty day, the number of flight segments, weather conditions, equipment on board (for example, an autopilot), or other factors that might affect a pilot's workload, and thus, a pilot's fatigue. The aviation regulatory authorities of Great Britain have adopted flight and duty time regulations that reflect information from fatigue and sleep-related research. These British regulations take into consideration a pilot's starting time and number of flight legs, as well as the total duty time.[86] The relevant British flight and duty time regulations for two or more flight crewmembers are summarized in table 4.

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[84] According to Corporate Airlines, its airplanes are not equipped with vertical navigation equipment for constant-angle-of-descent approaches.

[85] For additional information, see Aircraft Accident Report NTSB/AAR-00/01.

[86] See Civil Aviation Authority of Great Britain, *The Avoidance of Fatigue in Aircrews: Guide to Requirements*. CAP 371, Section B (2004): 9.

Table 4. British duty time regulations in hours (hrs) for flight crewmembers, in number of hours permitted.

Local start time	Number of flight legs							
	1 flight leg	2 flight legs	3 flight legs	4 flight legs	5 flight legs	6 flight legs	7 flight legs	8 flight legs
0600-0759	13 hrs	12.25 hrs	11.5 hrs	10.75 hrs	10 hrs	9.5 hrs	9 hrs	9 hrs
0800-1259	14 hrs	13.25 hrs	12.5 hrs	11.75 hrs	11 hrs	10.5 hrs	10 hrs	9.5 hrs
1300-1759	13 hrs	12.25 hrs	11.5 hrs	10.75 hrs	10 hrs	9.5 hrs	9 hrs	9 hrs
1800-2159	12 hrs	11.25 hrs	10.5 hrs	9.75 hrs	9 hrs	9 hrs	9 hrs	9 hrs
2200-0559	11 hrs	10.25 hrs	9.5 hrs	9 hrs	9 hrs	9 hrs	9 hrs	9 hrs

The Safety Board has issued numerous recommendations regarding length of duty issues, including Safety Recommendations I-89-02 and -03[87] and A-95-113.[88] However, despite repeated efforts to revise and update the flight and duty time rules that began in the mid- to late-1970s, there have been no significant changes to the Federal flight and duty time regulations in the U.S. since the Federal Aviation Regulations were recodified in 1964.

In May 1999, the Safety Board issued a safety report that evaluated the DOT's efforts to address operator fatigue in transportation. The Board's safety report stated that, "despite the acknowledgement by the DOT that fatigue is a significant factor in transportation accidents, little progress has been made to revise the hours-of-service regulations to incorporate the results of the latest research on fatigue and sleep issues."[89] As a result, the Board recommended that the FAA:

> Establish, within 2 years, scientifically based hours-of-service regulations that set limits on hours of service, provide predictable work and rest schedules, and consider circadian rhythms and human sleep and rest.[90]

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[87] These safety recommendations were issued to the Department of Transportation (DOT) and addressed upgraded regulations regarding hours of service, as well as the development and dissemination of educational materials regarding work and rest schedules and proper regimens of health, diet, and rest to personnel in all modes of transportation. The Safety Board has classified Safety Recommendation I-89-02, "Closed—Acceptable Response," and Safety Recommendation I-89-03, "Closed—Unacceptable Action/Superseded."

[88] This safety recommendation asked the FAA, in part, to "finalize the review of current flight and duty time regulations and revise the regulations, as necessary, within 1 year to ensure that flight and duty time limitations take into consideration research findings in fatigue and sleep issues." The Safety Board has classified Safety Recommendation A-95-113, "Open—Unacceptable Response."

[89] For additional information, see National Transportation Safety Board, *Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue,* Safety Report NTSB/SR-99/01 (Washington, DC: NTSB, 1999).

[90] This safety recommendation is on the Safety Board's "Most Wanted" list of transportation safety improvements.

In June 1999, the FAA published a notice of intent in the *Federal Register* indicating the agency's intent to enforce regulations concerning flight time limitations and rest requirements and issue a supplemental NPRM in spring 2001. However, at an October 1999 meeting, FAA personnel advised the Safety Board that the FAA would not be able to meet the recommendation's deadline for a new rule. In April 2001, the Safety Board indicated that it was frustrated by the FAA's lack of progress on this safety issue and classified Safety Recommendation A-99-45 "Open—Unacceptable Response."

In May 2001, the FAA published another Notice of Intent in the *Federal Register* reiterating its interpretation of regulations regarding pilot flight, duty, and rest times and restating that it intended to deal stringently with any violations. In October 2001, the Board wrote (in its final report on the American Airlines flight 1420 accident at Little Rock, Arkansas)[91] that, although it was encouraged by the FAA's increased efforts to enforce current pilot flight and duty time regulations, recent accidents highlighted the need to expedite efforts to comprehensively address the issue of fatigue in aviation. Therefore, the Board reiterated Safety Recommendation A-99-45 in that accident report.

The Safety Board has received no further correspondence from the FAA regarding this safety recommendation.[92] In its February 1, 2005, mandatory annual report to Congress regarding the regulatory status of the Safety Board's "Most Wanted" recommendations, the DOT wrote:

> The FAA issued an NPRM proposing to amend existing regulations to establish one set of duty period limitations, flight time limitations, and rest requirements for flight crewmembers engaged in air transportation. The FAA encountered a number of technical and operational issues as a result of the NPRM and is presently looking at alternatives.

Safety Recommendation A-99-45 remains classified, "Open—Unacceptable Response." No final rule addressing this issue has been issued to date.

1.18.5 Fatigue-Related Information

1.18.5.1 General

Since 1989, the Safety Board has issued more than 70 fatigue-related safety recommendations for all modes of transportation. In addition, human fatigue in transport operations has been included in the Board's annual list of Most Wanted Transportation Safety Improvements since the list's inception in September 1990. Research has shown that in general, long duty days can be associated with fatigue and degraded performance.

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[91] For additional information, see National Transportation Safety Board, *Runway Overrun During Landing, American Airlines Flight 1420, McDonnell Douglas MD-82, N215AA, Little Rock, Arkansas, June 1, 1999,* Aircraft Accident Report NTSB/AAR-01/02 (Washington, DC: NTSB, 2001).

[92] In preparation for its annual review of the Safety Board's "Most Wanted" list of transportation safety improvements, Board staff has requested an update from the FAA on this recommendation; these requests have not yet produced any updates on FAA action related to implementation of Safety Recommendation A-99-45.

For example, researchers[93] observed increased sleepiness and degraded performance in workers on a 12-hour shift when compared with those on an 8-hour shift. Workers on a 12-hour shift also reported reduced amount and quality of sleep.

Aviation accident data show that human-performance-related airline accidents are substantially more likely to happen when pilots work long days. For example, the Safety Board's 1994 study of flight-crew-related major aviation accidents[94] found that captains that had been awake for more than about 12 hours made significantly more errors than those that had been awake for less than 12 hours.[95] Such errors included failing to recognize and discontinue a flawed approach. In fatigue-related aviation accidents, pilots often exhibit a tendency to continue the approach despite increasing evidence that it should be discontinued.

Additionally, accident data[96] indicate that pilots who worked schedules that involved 13 or more hours of duty time showed an accident rate that was several times higher than that of pilots working shorter schedules. The research reported that there was a "discernable pattern of increased probability of an accident the greater the hours of duty time for commercial aircraft pilots in the United States." Figure 8 shows data from 55 human factors-related accidents involving U.S. air carriers between 1978 and 1999, as well as exposure data on pilot work patterns obtained from 10 airlines. About 1 percent of the schedules reviewed involved 13 or more hours of duty time; however, pilots flying these schedules had accident rates several times higher than pilots flying schedules with shorter duty days.

Research also indicated that fatigue increased with the number of flight segments in a duty day.[97] For example, an increase from one to four flight segments within a duty day increased fatigue an amount equivalent to an additional 2.77 hours on duty. In addition, research indicated that the hour at which a pilot awakens and/or is operating could result in fatigue-related degraded performance. Specifically, because the body is physiologically primed to sleep between 0300 and 0500, wakeup times in this range can result in fatigue-related degraded performance.[98]

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[93] R.R. Rosa, M.J. Colligan, and P. Lewis, "Extended Workdays: Effects of 8-Hour and 12-Hour Rotating Shift Schedules on Performance, Subjective Alertness, Sleep Patterns, and Psychosocial Variables," *Work and Stress*, Vol. 3, No. 1 (1989): 21-32.

[94] For additional information, see Safety Study NTSB/SS-94/01.

[95] There was evidence that the captain of flight 5966 napped on a small couch in the company crew rest room. Research indicates that, although naps are a recognized countermeasure for fatigue, the effect of a nap would only last a few hours. See M.R. Rosekind, R.C. Graeber, D.F. Dinges, L.J Connell, M.S. Rountree, C.L. Spinweber, and K.A. Gillin, "Crew Factors in Flight Operations: IX. Effects of Planned Cockpit Rest on Crew Performance and Alertness in Long-Haul Operations," Technical Memorandum 103884, (1994): National Aeronautics and Space Administration.

[96] J.H. Goode, "Are Pilots at Risk of Accidents Due to Fatigue?," *Journal of Safety Research*, Vol. 34 (2003): 309-313.

[97] See Civil Aviation Authority Paper 2005/04: *Aircrew Fatigue: A Review of Research Undertaken on Behalf of the UK [United Kingdom] Civil Aviation Authority.* (October 2005): 27-30.

[98] See T. Akerstedt, "Review Article: Shift Work and Disturbed Sleep/Wakefulness," *Sleep Medicine Reviews*, Vol. 2, No. 2 (1998): 117-128.

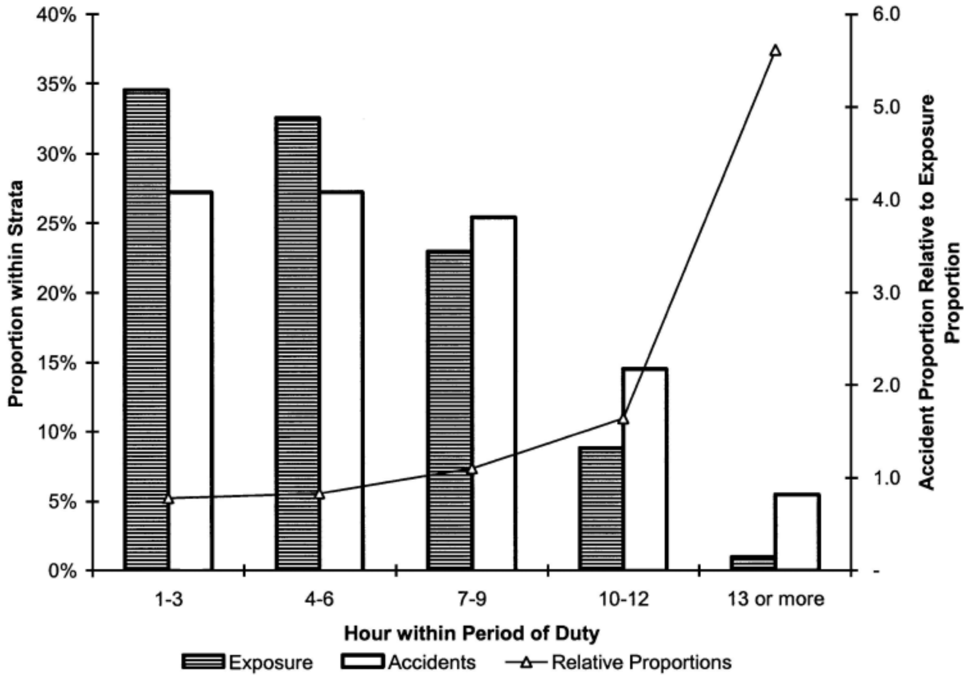

Figure 8. Aviation accident data from 55 accidents involving U.S. air carriers between 1978 and 1999, indicating that accidents are more prevalent as the length of the pilots' duty period increases.

For additional information, see J.H. Goode, "Are Pilots at Risk of Accidents Due to Fatigue?" *Journal of Safety Research*, 34 (2003): 309-313.

Research shows that fatigue can cause pilots to make risky, impulsive decisions, become fixated on one aspect of a situation, and react slowly to warnings or signs, which could result in an approach being continued despite evidence that it should be discontinued.[99] Additionally, research shows that people who are fatigued become less able to consider options and are more likely to become fixated on a course of action or a desired outcome.[100] For example, in its report on the June 1, 1999, accident involving American Airlines flight 1420 at Little Rock, Arkansas, the Safety Board noted that the pilots had been awake for more than 16 hours and on duty for 14 hours and that they demonstrated deficiencies that included failing to discontinue the approach in deteriorating weather conditions (in the Little Rock case, thunderstorms). The report concluded that, "the flight crew's impaired performance resulting from fatigue and the situational stress associated with the intent to land under severe meteorological circumstances contributed to the accident."

[99] See M.R. Rosekind, K.B. Gregory, D.L. Miller, E.L. Co, J.V. Lebacqz, and M. Brenner, "Evaluating Fatigue Factors in Accident Investigations: Description and Application of a Structured Approach," (2005): Special Supplement of *Aviation, Space Environmental Medicine*, in preparation. For additional information, see a) Aircraft Accident Report NTSB/AAR-01/02; (b) Aircraft Accident Report NTSB/AAR-00/01; (c) National Transportation Safety Board, *Uncontrolled Collision With Terrain, American International Airways Flight 808, Douglas DC-8-61, N814CK, U.S. Naval Air Station, Guantanamo Bay, Cuba, August 18, 1993*, Aircraft Accident Report NTSB/AAR-94/04 (Washington, DC: NTSB, 1994); and d) Safety Study NTSB/SS-94/01.

[100] J.A. Caldwell, "Fatigue in the Aviation Environment: An Overview of the Causes and Effect as well as Recommended Countermeasures," *Aviation, Space, and Environmental Medicine,* Vol. 68 (1997): 932-938.

1.18.5.2 Previously Issued Fatigue-Related Recommendations

Safety Recommendations A-94-5 and A-94-73 recommended that the FAA:

> Require U.S. air carriers operating under 14 CFR Part 121 to include, as part of pilot training, a program to educate pilots about the detrimental effects of fatigue, and strategies for avoiding fatigue and countering its effects. (A-94-5)

> Require that 14 CFR Part 135 air carriers provide aircrews, as part of their initial and recurrent training, information on fatigue countermeasures relevant to the duty/rest schedules being flown by the company. (A-94-73)

In response to these Safety Recommendations, on September 8, 1995, the FAA revised AC 120-51, Appendix 3, "Appropriate CRM Training Topics," to encourage operators to provide pilots with "factual information about the detrimental effects of fatigue and strategies for avoiding and countering its effects" as part of their pilot training programs.[101] Further, in December 1995, the FAA issued NPRM 95-18, "Flight Crewmember Duty Period Limitations, Flight Time Limitations and Rest Requirements," proposing to amend existing regulations to establish flight and duty time limitations and rest requirements for flight crewmembers. On January 16, 1996, Safety Recommendations A-94-5 and A-94-73 were classified "Closed—Acceptable Action."

1.18.5.3 Department of Transportation Operator Fatigue Management Program

The FAA recently participated (with other transportation modal administrations) in a DOT Human Factors Coordinating Committee, which led the DOT's Operator Fatigue Management Program effort to develop practical tools for use by individuals and industries to better maintain vigilance and alertness on the job. One such tool is a fatigue management reference guide.[102] The reference guide was intended to provide basic information to operators in all transportation modes on how to develop an effective fatigue management program using available scientific evidence and best industry practices. For example, the reference guide notes that one of the important components of a fatigue management training program is its ongoing evaluation and refinement. Further, the guide suggests that conducting pilot surveys and monitoring objective safety data to refine existing programs are among the best procedures for such evaluation and refinement. In addition, the DOT program has developed additional products for industry use, including:

[101] Although fatigue-related training is recommended in AC 120-51, it is not required by current regulations.

[102] U.S. Department of Transportation, (in draft 2003). Commercial Transportation Operator, Fatigue Management Reference. Washington, D.C.: DOT Research and Special Programs Administration. This work follows, in part, from previous Safety Board recommendations that the DOT develop and disseminate educational material for transportation industry personnel and management regarding shift work; work and rest schedule; and proper regimens of health, diet, and rest (Safety Recommendation I-89-2, which was classified, "Closed—Acceptable Action" on May 25, 2001).

- A fatigue management reference guide: a compendium of current science and practical information on approaches to fatigue management and countermeasure usage;
- A fatigue model validation procedure: a practical and methodologically sound approach for validating output from fatigue modeling software being tailored for transportation application;
- Work schedule representation and analysis software: a software tool to aid managers and schedulers in evaluating and designing ergonomic work schedules to promote on-duty alertness; and
- Program evaluation framework: a cross-modal fatigue management research logic model that provides a blueprint for evaluating current knowledge, information needs, and points of leverage between DOT agencies.

Further, the DOT is currently developing the following:

- Business case development tool suite: a documented methodology and supporting analytical tools to aid company safety managers in building a case for senior management support of fatigue management activities.

Recent interviews with DOT personnel indicated that the Federal Railroad Administration has begun validation tests on some of these tools in operational settings within the railroad industry. DOT personnel indicated that they would like future efforts to involve aviation and other transportation modes.

2. Analysis

2.1 General

The captain and first officer were properly certificated and qualified in accordance with, and had received the training and rest time prescribed by, Federal regulations and company requirements. The flight crewmembers possessed valid and current medical certificates appropriate for 14 CFR Part 121 flight operations.

The accident airplane was properly certificated and maintained and was equipped and dispatched in accordance with applicable regulations and industry practices. There was no evidence of any preexisting powerplant, system, or structural failure.

Loading for the accident flight was routine; no passenger or cargo anomalies were observed, and the airplane was operating within the prescribed weight and center of gravity limits. No hazardous materials were on board the airplane. The accident airplane's cargo and its loading were not factors in the accident.

The pilots received thorough, accurate, and pertinent weather information for their destination airport and were well aware that they would likely not descend beneath the clouds until at or near the MDA. Further, they had been flying in similar weather conditions (IMC with low ceilings and reduced visibilities in fog and mist) all day throughout the region. Although the weather conditions deteriorated slightly since they flew the approach earlier in the day, the CVR indicated that the pilots were aware of and prepared for the deteriorating conditions. In addition, airplanes landed in similar weather conditions without incident about an hour before and about an hour after the accident. Therefore, the Safety Board concludes that, although the weather did not cause this accident, the low ceiling and reduced visibility at IRK made the nonprecision approach more challenging.

Corporate Airlines pilots (former and current) and FAA inspectors provided positive comments about the company and its procedures and training. The company's training program included CFIT and CRM training and was described as tough and thorough. Although Corporate Airlines' schedules occasionally resulted in long duty days, they satisfied Federal flight and duty time requirements.[103] There was no evidence of company-wide deficiencies or company pressure on pilots to fly fatigued or to complete difficult approaches. Therefore, the Safety Board concludes that Corporate Airlines' policies, procedures, and training were consistent with industry standards.

The accident occurred after ATC had cleared the pilots for a nonprecision approach to an uncontrolled airport. ATC was not a factor in the accident.

Because of the rural location of the accident site and the communication challenges inherent in off-airport accidents involving uncontrolled airports, emergency

[103] For additional information, see section 2.5.

response personnel arrived at the accident site about 40 minutes after the accident. The cause of death for all fatally injured airplane occupants was determined to be multiple blunt force injuries experienced during the impact sequence. It is likely that the two survivors were less severely injured because of their seat locations in the airplane (over the main wing spar near a postaccident break in the fuselage); as a result, they were able to promptly exit the burning airplane.[104] The Safety Board concludes that the emergency response did not adversely affect the survivability of this accident.

The Safety Board notes that the GPWS installed on the accident airplane provided a "sink rate" alert about 3 seconds before initial impact, which was consistent with the unit's design. By contrast, an EGPWS, which is now required by Federal regulations would have provided a "too low terrain" alert about 10 seconds before impact (shortly after the airplane descended through the MDA) and would have repeated this alert every 3 seconds until the airplane's descent profile was corrected. Corporate Airlines had equipped 2 of its 12 operating airplanes (but not the accident airplane) with EGPWS when the accident occurred and equipped its remaining fleet with EGPWS before March 29, 2005, in compliance with FAA requirements. The Safety Board concludes that an EGPWS (required by Federal regulation since March 29, 2005), would have provided the pilots with a "too low terrain" alert in sufficient time to avoid collision with the trees.

This analysis will focus on the pilots' decisions and performance to consider why neither pilot recognized and/or took action to correct the airplane's descent rate and proximity to the ground during the later stages of the approach to IRK. Specifically, this analysis will evaluate operational and human factors issues, including: pilot professionalism and sterile cockpit procedures, nonprecision instrument approach procedures, flight and duty time regulations, fatigue, and FDR/image recorder requirements.

2.2 The Accident Sequence

Examination of the CVR and FDR data indicated that the en route portion of the accident flight from STL to IRK was routine. The captain had thoroughly briefed the nonprecision, instrument approach, including the MDA and missed approach procedures. The initiation of the approach was consistent with company procedures; when the airplane passed the FAF on the approach, the pilots began a 1,200 fpm rate of descent to the MDA. The Safety Board notes that Corporate Airlines' flight manual indicates that a 1,200 fpm descent rate from 1,000 feet agl down to 300 feet agl is consistent with a stabilized approach. Although this descent rate is not prohibited by the FAA, it is not consistent with the FAA's guidance, which indicates that one of the criteria for a stabilized approach is a descent rate no greater than 1,000 fpm below 1,000 feet agl. The Safety Board concludes that although the accident airplane's 1,200 fpm rate of descent was consistent with company procedures, it varied from current FAA guidance that recommends a descent rate of no more than 1,000 fpm below 1,000 feet agl.

[104] Although emergency response communication and coordination issues were identified (for example, the initial LPFD responders and IC were operating on a different radio frequency than law enforcement personnel), the issues were not causal to this accident and have since been addressed.

As the approach continued, however, neither pilot followed standard company nonprecision approach procedures. Table 5 lists proper procedural requirements and callouts (with the acting pilot, if applicable), the accident pilots' actions and responses, and pertinent remarks where applicable.

Table 5. Proper procedural requirements and callouts (with the acting pilot, if applicable), the accident pilots' actions and responses, and pertinent remarks where applicable. Italics text indicates deviations from procedures.

Procedural requirements/callouts (acting pilot, if applicable)	Accident pilot actions and responses	Pertinent remarks
Regulations and procedures prohibit non-essential flight crew conversation below 10,000 feet msl	*See CVR transcript in appendix B.*	
"Flaps 10" callout (flying pilot)	"Flaps 10" callout (flying pilot) "Flaps 10" response (nonflying pilot, after flaps 10 were selected)	
"Course alive, crosschecked, no flags" callout (nonflying pilot)	"Course alive, cross check, no flags except for the vertical" callout (nonflying pilot)	
"Gear down, flaps 20, before landing check" callout (flying pilot)	"Gear down, flaps 20, before landing check" callout (flying pilot)	The nonflying pilot then performed the before landing checklist
"100 feet above minimums" callout (nonflying pilot)		*No such callout was recorded by the CVR.*
"Minimums" callout and look for pertinent ground references (nonflying pilot)	*"Thirteen twenty" - callout (nonflying pilot)*	1,320 feet msl was the MDA
If pertinent ground references are not clearly visible to the nonflying pilot level off at the MDA and monitor cockpit flight instruments (flying pilot)	*As the airplane continued its descent to and through the MDA, the flying pilot stated, "I can see ground there" and "what do you think?"*	*Contrary to procedures and training, the flying pilot was looking for external visual references during the approach, rather than leveling off and monitoring the flight instruments*
If pertinent ground references are not clearly visible to the nonflying pilot continue to look for pertinent ground references (nonflying pilot).	*After the flying pilot said he saw the ground, the nonflying pilot stated, "I can't see [expletive]."*	• Consistent with procedures, the nonflying pilot was looking for pertinent ground references. • *The nonflying pilot did not challenge the flying pilot's continued descent.*
"Runway in sight" callout (nonflying pilot)	*"Yeah, oh there it is, approach lights in sight" statement (flying pilot)*	*Contrary to procedures, the flying pilot was the first to say that he had visual cues allowing descent below MDA. Further, this nonstandard callout was recorded after the airplane was below the MDA.*
Company procedures dictate descent rates of no more than 900 fpm below 300 feet agl.	*The accident airplane's descent rate was consistently about 1,200 fpm until immediately before it struck the trees.*	*The first officer failed to challenge the continued 1.200 fpm rate of descent below 300 feet agl.*
"Going visual, leaving minimums, flaps 35" callout (flying pilot)		*No such callout was recorded by the CVR; however,the first officer offered and the captain declined selection of flaps 35 about 4 seconds before impact.*

CVR evidence indicated that just before the GPWS announced that the airplane was at the MDA (at 1936:36.8), the captain stated, "I can see ground there."[105] About 6 seconds later, the captain stated that he could see the approach lights. The captain's statements indicated that, contrary to company procedures, he was looking outside the cockpit for visual references. Corporate Airlines' procedures dictated that if the nonflying/monitoring pilot (the first officer) did not see the required visual cues when the airplane reached the MDA (and in this case, his comment at 1936:41.9 indicated that he did not), the flying pilot (the captain) should level off and remain at the MDA until those cues came into sight or until the airplane reached the MAP.[106]

As the airplane was about 170 feet below the MDA (about 194 feet agl, 8 seconds after the airplane descended through the MDA), the first officer stated, "in sight…continue." CVR evidence clearly indicates that both pilots were referring to external cues and not referencing the necessary cockpit instrumentation. In fact, although company procedures dictated descents of no more than 900 fpm below 300 feet agl, the airplane was still descending at a rate of about 1,200 fpm as it descended through about 100 feet agl.

As the airplane descended through about 100 feet agl, the first officer suggested selecting landing flaps (35°); the captain turned down the suggestion. The decision not to extend landing flaps suggests that the captain was not completely committed to a landing, although he said he saw the approach lights. However, the captain's failure to stop or slow the airplane's descent indicates that he was not aware of the airplane's excessive descent rate and/or significantly misjudged its proximity to the ground.

Although current FAA regulations permit pilots to descend below the MDA to 100 feet above the TDZE after they observe the approach lights,[107] such a descent may not be advisable under all circumstances. During an approach at night, in reduced visibility, approach lights alone would not provide an adequate sight picture for the pilots to make an appropriate approach to the runway. With only an approach light or lights for approach path reference, a pilot could focus on those lights while flying into the ground. Pilots who had flown into IRK at night told investigators that, other than the airport's lighting systems, there were minimal lights or ground references beneath the approach course that would have helped the pilots judge the airplane's position relative to the runway or height above terrain.[108]

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[105] It is not clear what the captain was looking at when he reported seeing the ground. On the basis of IRK ASOS weather observations and other pilot reports, it is likely that the airplane was skimming the bottom of the clouds as it descended through the MDA. The approach path was over farmland and woods, and postaccident interviews with local residents and other pilots indicated that there were few, if any, light sources (except the airport lights) or other ground references that were visible at night in the area.

[106] At the MAP, if the pilots do not see the approach lights or runway environment, company and published approach procedures require a missed approach.

[107] For additional information, see section 2.4.

[108] On the basis of the airplane's altitude, its distance from the runway, the relative brightness of the approach lights, and the fact that the VASI glidepath does not intercept the MDA until closer to the airport, the VASI lights would have appeared solid red and therefore would not have provided the pilots with much usable information.

The Safety Board concludes that the pilots failed to follow established procedures to effectively monitor the airplane's descent rate and height above terrain during the later stages of the approach and relied too much on minimal external visual cues. Although descent rate and altitude information were readily available through cockpit instruments, both pilots were largely preoccupied with looking for the approach lights.

2.3 Crew Performance/Professionalism

Cockpit communications recorded by the CVR indicated that the pilots frequently engaged in conversation that lacked a professional tone during the accident flight. The Board considered whether these unprofessional communications (some of which were made during a critical phase of flight below 10,000 feet msl and therefore were not consistent with FAA and Corporate Airlines sterile cockpit procedures) were a factor in this accident.

CVR evidence indicated that the pilots appeared to be comfortable with each other and enjoyed flying and joking together. To an extent, this working relationship might have been a benefit in the cockpit. Humor can play an important function in promoting crew cohesion, coordination, and tension reduction; it is reasonable to expect that a crew that works together for several days may develop an effective interaction style that involves humor. However, research has shown that flight crews that focus more on social cohesion than on-task team work may not perform as effectively as other flight crews and may be distracted from standard procedures.[109]

When the relationship between colleagues is excessively relaxed, there may be a tendency for professionalism to be compromised and pilot responsibilities to be adversely affected. Flight crewmembers must be alert to these possibilities to avoid degraded situational awareness and adhere to standard operating procedures and professionalism. Also, in an excessively relaxed relationship, there may be a tendency for overconfidence and over-reliance on each other. The pilots' professional demeanor was probably degraded as a result of their relationship and relaxed behavior; these factors may also have detracted from the pilots' adherence to company standard procedures and callouts.

Federal regulations regarding sterile cockpit procedures are intended to prevent casual crew interactions from interfering with the careful execution of critical pilot actions, such as altitude and course control during nonprecision instrument approaches. These rules allow more casual flight crew interactions during operations above 10,000 feet msl, when the workload is relatively low, while expressly prohibiting nonessential flight crew conversations/interactions below 10,000 feet msl, when the workload is relatively high.

[109] D. Druckman and J.A. Swets, *Enhancing Human Performance: Issues, Theories, and Techniques*, National Academy Press (1988): 159-163.

The captain, as the pilot-in-command, had the authority and responsibility to set the cockpit tone for the approach. However, the accident captain was known among coworkers for his sense of humor and CVR evidence indicated that he emphasized fun in the cockpit. Had he emphasized the pilots' goals and strategies as they prepared for the nonprecision approach in night IMC conditions, it is likely that the accident pilots would have suspended their humorous banter and engaged in only operationally relevant conversation below 10,000 feet msl. The captain's continued joking during this period established an inappropriate cockpit orientation for this phase of the flight and was not consistent with standard operating procedures. Both pilots' attitudes and inattention during subsequent operations demonstrated a lack of regard/respect for their responsibilities and duties.

Despite the pilots' unprofessional verbal behavior throughout much of the flight, CVR, FDR, ATC, and radar information indicated that they were generally attentive to required flight-related duties until shortly before the accident. For example, the pilots were very attentive to the weather conditions (low ceilings and reduced visibility) at IRK, checking and rechecking the IRK ASOS observations as they approached the airport. Additionally, the captain provided a thorough landing briefing in which he stated the MDA and runway TDZE (1,320 and 964 feet, respectively) and reviewed the missed approach procedures. He also restated the MDA as he began the approach.

However, despite their apparent awareness of proper approach procedures and altitudes, the pilots continued their 1,200 fpm descent below the MDA without an appropriate visual reference. The captain should have leveled off and focused on the flight instruments and the first officer should have instructed him to level off. It was apparent that they did not have the requisite visual cues needed to descend further at that time. Instead, about 2 seconds after the airplane descended through the MDA, still descending about 1,200 fpm, the captain asked the first officer, "what do you think?" About 4 seconds later, the first officer responded, "I can't see [expletive]."

Corporate Airlines' procedures dictated that the first officer was to monitor the approach and report deviations from standard company approach procedures. During the accident approach, the first officer occasionally provided the captain with appropriate nonflying/monitoring pilot support (such as when he prompted the approach checklist, provided DME callouts, repeated the MDA altitude, and prompted landing flaps). However, there were several instances in which the first officer failed to provide company-required callouts or provided nonstandard callouts. For example, he was required to callout "100 feet above minimums" and "minimums," as the airplane descended through those altitudes, but instead he made a single callout of "thirteen twenty" as the airplane approached the MDA. Most significantly, the first officer did not challenge the captain's failure to level off at or reduce the airplane's rate of descent around the MDA, despite the fact that the first officer did not see any ground references and was responsible for monitoring the progress of the approach.[110]

[110] The Safety Board notes that careful adherence to standard procedures and division of responsibility in the cockpit can significantly help pilots limit the degrading effects of fatigue. The role of fatigue in this accident is discussed in section 2.5.

The first officer appeared to be engaged in appropriate nonflying/monitoring pilot activities during the later stages of the approach; he was looking for external visual references and stated, "in sight, continue" when he eventually observed the approach lights (about 11 seconds after the airplane descended through the MDA). He also prompted the captain regarding the landing flap configuration late in the approach. However, when the descent continued below the MDA, the first officer did not aggressively express concern even though he did not yet see the approach lights. It is possible that the first officer was not aware that the airplane had not leveled off at the MDA because, as the nonflying/monitoring pilot, he was primarily looking for external visual references. However, it is also possible that the first officer did not challenge the captain because he was hesitant to be perceived as criticizing him. The Safety Board's 1994 safety study showed that accidents that involve human performance deficiencies are much more likely to occur when the captain is the flying pilot. This finding has been widely interpreted as indicative of the difficulty that first officers may have in challenging a captain because of the difference in experience and cockpit authority gradient between the two crewmembers.

The Safety Board concludes that the pilots' nonessential conversation below 10,000 feet msl was contrary to established sterile cockpit regulations and reflected a demeanor and cockpit environment that fostered deviation from established standard procedures, CRM disciplines, division of duties, and professionalism, reducing the margin of safety well below acceptable limits during the accident approach and likely contributing to the pilots' degraded performance. Further, the Safety Board concludes that compliance with sterile cockpit rules likely would have resulted in an increased focus on standard procedures and professionalism during the accident flight. Further, there is no evidence to indicate that this flight crew was unique in their behavior. Therefore, the Safety Board believes that the FAA should direct the POIs of all 14 CFR Part 121 and 135 operators to reemphasize the importance of strict compliance with the sterile cockpit rule.

2.4 Nonprecision Instrument Approach Techniques

Industry nonprecision instrument approach practices include two basic techniques: a traditional technique in which pilots descend rapidly to the MDA, level off, and fly to the MAP; and a constant-angle-of-descent technique in which the pilots establish a more moderate rate of descent calculated to reach the MDA just before the MAP. Corporate Airlines trained its pilots to use a traditional approach technique when performing nonprecision instrument approaches. Thus, when the airplane crossed the FAF, the pilots were to establish the airplane in a descent that allowed it to reach the MDA well before the MAP, then level off. The approach flown by the accident pilots was consistent with a traditional method nonprecision instrument approach until they continued their descent below the MDA. The Safety Board reviewed the constant-angle-of-descent approach technique (which is recommended where practicable by the FAA and FSF) to determine whether it might have helped the pilots avoid this accident.

Unlike a traditional approach, a constant-angle-of-descent approach technique involves establishing and maintaining a constant descent angle and moderate descent rate from the FAF toward the approach end of the runway and arriving and leveling off at the MDA at a point at or slightly before reaching the MAP. (Although the accident pilots maintained a relatively consistent angle of descent, their descent was steeper than that involved in a constant-angle, moderate-rate descent; as a result, the airplane reached the MDA almost 2 miles before the MAP and then did not level off.)

The use of the constant-angle-of-descent technique is typically dependent on the use of position and altitude information (for example, DME and the altimeter) to determine the necessary vertical flightpath. If used for the accident approach, the constant-angle-of-descent approach would likely have provided a stabilized flightpath with a relatively shallow angle of descent such that the airplane would reach the MDA at or slightly before the MAP.[111] The accident captain would likely have needed only minimal adjustments to maintain the correct descent profile to land within the touchdown zone on the runway. The pilots would have been closer to the airport when they reached the MDA, which would have facilitated their acquisition of visual cues indicating the airport environment, so they could maintain a normal descent to the runway and thus avoid obstacles during the descent from the MDA to the runway. The Safety Board concludes that the use of a constant-angle-of-descent approach technique, with its resultant stabilized, moderate rate-of-descent flightpath, and obstacle clearance, would have better positioned the accident airplane for a successful approach and landing. Therefore, the Safety Board believes that the FAA should require all 14 CFR Part 121 and 135 operators to incorporate the constant-angle-of-descent technique into their nonprecision approach procedures and to emphasize the preference for that technique where practicable.

2.4.1 Descent Below the Minimum Descent Altitude on Nonprecision Approaches

Current Federal regulations permit pilots to descend below the MDA to 100 feet above the runway TDZE if the airport approach lights are in sight.[112] However, the pilots must positively maintain obstacle clearance without the electronic vertical profile guidance that they would receive during a precision approach or the proper vertical profile they would maintain if performing a nonprecision constant-angle-of-descent approach. According to the FAA, published nonprecision approach procedures ensure obstacle clearance throughout the descent to the MDA but do not ensure obstacle clearance below this altitude. Therefore, it is critical that pilots refrain from descending

[111] Additionally, use of the constant-angle-of-descent approach technique would eliminate the need to descend to 100 feet above the touchdown zone before reaching the runway. In marginal weather conditions, the procedure permitting descent to 100 feet above the TDZE could have a potential for attracting pilots into an unsafe environment.

[112] Evidence (interviews with other Corporate Airlines pilots, examination of Corporate Airlines' operations, and review of FDR data from the accident pilots' previous approach to IRK) indicates that the accident pilots were aware of the Federal regulations allowing them to descend below the MDA if they had the approach lights in sight and took advantage of it if necessary.

below the MDA unless at least one of several very specific approach lighting or runway environment items is "distinctly visible and identifiable" to them, to provide guidance to the runway.

This accident occurred after the pilots continued their descent through the MDA and even through 100 feet above the TDZE (1,064 feet msl), without adequate visual reference to the approach lights or runway environment. At night with low ceilings, reduced visibility, and limited visual cues (ground lights, etc.), it would have been very difficult for the pilots to detect obstacles along the approach path through external visual cues, let alone visually assess the airplane's descent rate, distance from the airport, and height above the ground. The pilots (whom CVR evidence indicated wanted to land at IRK at the end of a long day and who likely began to see that they were breaking out of the clouds around the MDA) were apparently motivated to descend below the MDA to acquire visual cues that would allow them to continue the approach. The accident airplane initially impacted trees about 996 feet msl, which was about 62 feet below the "100 feet above TDZE" altitude.

The Safety Board concludes that current regulations permitting pilots to descend below the MDA into a region where obstacle clearance is not assured results in reduced margins of safety for nonprecision approaches, especially in conditions of low ceilings, reduced visibility, and/or at night. Further, these regulations can have the unintended effect of encouraging some pilots to descend below the MDA in an attempt to acquire visual cues that will permit them to continue the approach, as occurred in this case. Therefore, the Safety Board believes that the FAA should revise applicable 14 CFR Part 121 and 135 regulations to prohibit pilots from descending below the MDA during nonprecision instrument approaches unless conditions allow for clear visual identification of all obstacles and terrain along the approach path or vertical guidance to the runway is available and being used.

2.5 Pilot Flight and Duty Time and Fatigue Issues

The Safety Board evaluated fatigue as a possible factor in this accident and looked at the various circumstances present the day of the accident that may have contributed to the pilots' fatigue, including hours of rest, waking time, length of the duty day, and workload. The pilots' available rest time (from about 2100 to about 0400) did not correspond favorably with either pilot's reported usual sleeping hours, resulting in much earlier than normal times to go to sleep and awaken.[113] Additionally, the early wakeup call times[114] would have been challenging to both pilots because the human body is normally physiologically primed to sleep between 0300 and 0500.

[113] According to the captain's fiancée, when he did not have work demands, the captain normally went to sleep about midnight and awoke about 0630 or 0700; further, he had indicated that he had difficulty sleeping the night before the accident. The first officer's mother reported that when he did not have work demands, the first officer's sleep schedule was variable, depending on social and flight instruction obligations; however, she was often asleep before he returned home.

[114] Records indicate that the captain and first officer received hotel wakeup calls at 0410 and 0430, respectively.

Other important factors that would facilitate the development of fatigue in the accident pilots included the length of their duty day and the type of flying throughout that day (and the two previous days). At the time of the accident, it had been more than 15 hours since the pilots' last significant sleep period, and they had been on duty for 14 1/2 hours. The captain was observed resting on a small couch in the company crew room in STL between flights; however, the quality of rest the captain obtained during this time could not be determined, and company pilots stated that the crew room was a noisy meeting area that was not ideal for sleeping. Further, although naps are a recognized countermeasure for fatigue, research indicates that the effect of a nap would only last a few hours. Therefore, any sleep the captain got during this rest period probably had little fatigue-reducing effect by the time of the accident.[115]

The Safety Board's 1994 study of flight crew-related major aviation accidents indicated that fatigue related to lengthy periods of wakefulness can contribute to accidents. Specifically, the Board's study found that captains who had been awake for more than about 12 hours made significantly more errors than those who had been awake for less than 12 hours; such errors included failing to discontinue a flawed approach.[116] Further, accident data show that long duty days significantly increase the likelihood of human factors-related accidents. Pilots who flew schedules involving 13 or more hours of duty time had accident rates several times higher than pilots who flew shorter schedules.

Additionally, the pilots' high workload during their long day may have increased their fatigue. The accident occurred during the sixth flight segment of the day while the pilots were performing a nonprecision approach in low ceilings and reduced visibility.

The pilot deficiencies observed in this accident could be consistent with fatigue impairment. Research and accident history indicate that fatigue can cause pilots to make risky, impulsive decisions, to become fixated on one aspect of a situation, and to react slowly to warnings or signs that an approach should be discontinued. Fatigue especially affects decision making, and research shows that people who are fatigued become less able to consider options and are more likely to become fixated on a course of action or a desired outcome. Among pilots, this may appear as errors such as failing to discontinue a flawed approach.

Consistent with the degrading effects of fatigue, the captain made a risky decision to continue the approach based on inadequate visual cues, fixated on visual information to the exclusion of critical information on descent rate and altitude available on the airplane's instruments, and failed to discontinue the flawed approach although he was unable to acquire external visual cues that would assure a safe landing. Similarly, although the first officer's junior status with the company may have been an issue in his failure to challenge

[115] As previously mentioned, the CVR recorded yawning sounds from both the captain (about 1915:03) and the first officer (about 1923:43, 1925:44, and 1929:27) during the flight.

[116] For example, in its investigation of the June 1, 1999, accident involving American Airlines flight 1420 at Little Rock, Arkansas, in which the pilots continued a flawed approach, the Safety Board noted that the pilots had been continuously awake for at least 16 hours.

the captain during the approach, he may also have been suffering from fatigue; his failure to monitor and react to the captain's deviations from nonprecision approach procedures was consistent with the degrading effects (slowed reactions and/or tunnel vision) of fatigue.

The Safety Board concludes that, on the basis of the less than optimal overnight rest time available, the early reporting time for duty, the length of the duty day, the number of flight legs, the demanding conditions (nonprecision instrument approaches flown manually in conditions of low ceilings and reduced visibilities) encountered during the long duty day (and the two previous days), it is likely that fatigue contributed to the pilots' degraded performance and decision-making.

Despite repeated recommendations from the Safety Board (including Safety Recommendation A-99-45), the FAA has not revised its pilot flight and duty time regulations. The Safety Board notes that regulations such as those adopted by Great Britain provide clear, easy-to-understand limits with which industry can develop schedules to optimize pilot utilization while respecting factors identified in current scientific literature as conducive to fatigue. The Safety Board concludes that existing FAA pilot duty regulations do not reflect recent research on pilot fatigue and sleep issues, increasing the possibility that pilots will fly in a fatigued condition. Therefore, the Safety Board believes that the FAA should modify and simplify the flight crew hours-of-service regulations to take into consideration factors such as length of duty day, starting time, workload, and other factors shown by recent research, scientific evidence, and current industry experience to affect crew alertness. Further, because the FAA has not taken suitable action regarding Safety Recommendation A-99-45 since it was issued in 1999, the Safety Board classifies Safety Recommendation A-99-45 "Closed—Superseded."

2.5.1 Training

Although the FAA revised AC 120-51, "Crew Resource Management Training," Appendix 3, "Appropriate CRM Training Topics," to encourage operators to provide pilots with information about the detrimental effects of fatigue and strategies for avoiding and countering its effects as part of their CRM training programs, such training is not required by current regulations. Although many airlines have incorporated such training into their programs, at the time of the accident, Corporate Airlines did not provide its pilots with fatigue-related instruction in its CRM or other training modules.[117]

The Safety Board notes that the FAA participated (with other transportation modal administrations) in a DOT Operator Fatigue Management Program effort to develop a fatigue management reference guide. The reference guide was intended to provide basic information to operators in all transportation modes about how to develop an effective fatigue management program using available scientific evidence and industry best

[117] As previously stated, Corporate Airlines' CRM training was a 6-hour session that addressed CRM concepts and policies of cockpit responsibility and duties during flight, as required by regulation.

practices. In addition, the DOT program has developed additional products for industry use, such as software to aid in designing work schedules that promote alertness. Such products can provide useful guidelines and tools for companies that are willing to go beyond current regulations by developing and implementing a fatigue management program. DOT personnel are currently developing a tool to aid company safety managers in building a case for support of fatigue management activities.

The circumstances of this accident demonstrate the continuing need for fatigue management in the aviation industry. The Safety Board concludes that providing pilots with additional fatigue-related training, such as that being developed by the DOT Operator Fatigue Management Program, may increase their awareness and use of fatigue avoidance techniques and thus improve safety margins. Therefore, the Safety Board believes that the FAA should require all 14 CFR Part 121 and 135 operators to incorporate fatigue-related information similar to that being developed by the DOT Operator Fatigue Management Program into their initial and recurrent pilot training programs; such training should address the detrimental effects of fatigue and include strategies for avoiding fatigue and countering its effects.

2.6 Flight Recorder Requirements

Current 14 CFR Part 121 FDR standards for newly manufactured airplanes require FDRs to record 88 parameters of data. The accident airplane was in a category that was not required to be so equipped. Given the limited predicted life of these airplanes, the FAA allowed exceptions to this rule, indicating that upgrading existing FDR equipment to record additional parameters on older airplanes would require extensive modifications and was not cost effective.

The Safety Board notes that the FDR is an important investigative tool that can be used to determine operational actions and an airplane's performance. Because the information that investigators learn from FDR data can help prevent accidents and incidents from recurring, FDRs that record only a limited number of parameters can adversely affect safety. However, new technology (specifically, onboard image recorders) provides an economical means of supplementing parametric information on airplanes operating with FDRs recording fewer parameters. Image recorders have the added advantage of providing additional information that would not be readily obtained from the CVR and/or FDR, such as the environment within the cockpit and outside the cockpit window and the manipulation of controls and switches in the cockpit.

In April 2000, the Safety Board issued Safety Recommendation A-00-30 to the FAA, asking the FAA to require that all aircraft operated under 14 CFR Parts 121, 125, or 135 and currently required to be equipped with a CVR and FDR be retrofitted by January 1, 2005, with a crash-protected cockpit image recording system. (See section 1.11.2.1 for more information about this recommendation.) Despite the Board's recommendation, a February 2005 NPRM titled, "Revisions to Cockpit Voice Recorder and Digital Flight Data Recorder Regulations," did not address image recorders.

During this investigation, the Safety Board learned that several aircraft like the BAE-J3201 are currently used in Part 121 passenger-carrying operations with minimal, if any, recorded data,[118] which is unacceptable. The Safety Board understands that the cost of retrofitting these aircraft with FDRs to meet the current standard for newly manufactured aircraft may be cost-prohibitive. However, image recorder technology that is currently available offers a cost-effective solution and would capture important data that would otherwise be lost in an investigation. For example, in this accident an image recorder might have provided information regarding where the pilots were looking and what they might have seen through the windshield as they descended below the MDA. The Safety Board concludes that capturing the maximum recorded data possible is necessary for a more effective reconstruction of the events that lead to accidents and the issuance of more timely safety recommendations to prevent similar accidents from recurring. Therefore, the Safety Board reiterates Safety Recommendations A-00-30 for airplanes that are currently required to be equipped with both a CVR and FDR and Safety Recommendation A-03-65 for airplanes that are required to be equipped with a CVR.

[118] It is possible that some airplanes that entered the U.S. registry before October 11, 1991, and are currently used in Part 121 passenger-carrying operations might only be equipped with a CVR and not an FDR. The Safety Board previously recommended image recorders for airplanes that are only equipped with a CVR in Safety Recommendation A-03-65.

3. Conclusions

3.1 Findings

1. The captain and first officer were properly certificated and qualified in accordance with, and had received the training and rest time prescribed by, Federal regulations and company requirements. The flight crewmembers possessed valid and current medical certificates appropriate for 14 *Code of Federal Regulations* Part 121 flight operations.

2. The accident airplane was properly certificated and maintained and was equipped and dispatched in accordance with applicable regulations and industry practices. There was no evidence of any preexisting powerplant, system, or structural failure.

3. The accident airplane's cargo and its loading were not factors in the accident.

4. Although the weather did not cause this accident, the low ceiling and reduced visibility at Kirksville Regional Airport made the nonprecision approach more challenging.

5. Corporate Airlines' policies, procedures, and training were consistent with industry standards.

6. Air traffic control was not a factor in the accident.

7. The emergency response did not adversely affect the survivability of this accident.

8. An enhanced ground proximity warning system (required by Federal regulation since March 29, 2005), would have provided the pilots with a "too low terrain" alert in sufficient time to avoid collision with the trees.

9. Although the accident airplane's 1,200 feet per minute (fpm) rate of descent was consistent with company procedure, it varied from current Federal Aviation Administration guidance that recommends a descent rate of no more than 1,000 fpm below 1,000 feet above ground level.

10. The pilots failed to follow established procedures to effectively monitor the airplane's descent rate and height above terrain during the later stages of the approach and relied too much on minimal external visual cues. Although descent rate and altitude information were readily available through cockpit instruments, both pilots were largely preoccupied with looking for the approach lights.

11. The pilots' nonessential conversation below 10,000 feet mean sea level was contrary to established sterile cockpit regulations and reflected a demeanor and cockpit environment that fostered deviation from established standard procedures, crew resource management disciplines, division of duties, and professionalism, reducing the margin of safety well below acceptable limits during the accident approach and likely contributing to the pilots' degraded performance.

12. Compliance with sterile cockpit rules may have resulted in an increased focus on standard procedures and professionalism during the accident flight.

13. The captain should have, but did not, arrest the airplane's rapid descent when they reached the minimum descent altitude (MDA), and the first officer should have, but did not, challenge the captain's descent below the MDA.

14. The use of a constant-angle-of-descent approach technique, with its resultant stabilized, moderate rate-of-descent flightpath, and obstacle clearance, would have better positioned the accident airplane for a successful approach and landing.

15. Current regulations permitting pilots to descend below the minimum descent altitude (MDA) into a region where obstacle clearance is not assured may result in reduced margins of safety for nonprecision approaches, especially in conditions of low ceilings, reduced visibility, and/or at night. Further, these regulations can have the unintended effect of encouraging some pilots to descend below the MDA in an attempt to acquire visual cues that will permit them to continue the approach, as occurred in this case.

16. On the basis of the less than optimal overnight rest time available, the early reporting time for duty, the length of the duty day, the number of flight legs, the demanding conditions (nonprecision instrument approaches flown manually in conditions of low ceilings and reduced visibilities) encountered during the long duty day (and the two previous days), it is likely that fatigue contributed to the pilots' degraded performance and decisionmaking.

17. Existing Federal Aviation Administration pilot duty regulations do not reflect recent research on pilot fatigue and sleep issues, increasing the possibility that pilots will fly in a fatigued condition.

18. Providing pilots with additional fatigue-related training, such as that being developed by the Department of Transportation Operator Fatigue Management Program, may increase their awareness and use of fatigue avoidance techniques and thus improve safety margins.

19. Capturing the maximum recorded data possible is necessary for a more effective reconstruction of the events that lead to accidents and the issuance of more timely safety recommendations to prevent similar accidents from recurring.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the pilots' failure to follow established procedures and properly conduct a nonprecision instrument approach at night in instrument meteorological conditions, including their descent below the minimum descent altitude (MDA) before required visual cues were available (which continued unmoderated until the airplane struck the trees) and their failure to adhere to the established division of duties between the flying and nonflying (monitoring) pilot.

Contributing to the accident were the pilots' failure to make standard callouts and the current Federal Aviation Regulations that allow pilots to descend below the MDA into a region in which safe obstacle clearance is not assured based upon seeing only the airport approach lights. The pilots' failure to establish and maintain a professional demeanor during the flight and their fatigue likely contributed to their degraded performance.

4. Recommendations

4.1 New Recommendations

As a result of the investigation of the Corporate Airlines flight 5966 accident, the National Transportation Safety Board makes the following recommendations to the Federal Aviation Administration:

> Direct the principal operations inspectors of all 14 *Code of Federal Regulations* Part 121 and 135 operators to reemphasize the importance of strict compliance with the sterile cockpit rule. (A-06-7)
>
> Require all 14 *Code of Federal Regulations* Part 121 and 135 operators to incorporate the constant-angle-of-descent technique into their nonprecision approach procedures and to emphasize the preference for that technique where practicable. (A-06-8)
>
> Revise applicable 14 *Code of Federal Regulations* Part 121 and 135 regulations to prohibit pilots from descending below the minimum descent altitude during nonprecision instrument approaches unless conditions allow for clear visual identification of all obstacles and terrain along the approach path or vertical guidance to the runway is available and being used. (A-06-9)
>
> Modify and simplify the flight crew hours-of-service regulations to take into consideration factors such as length of duty day, starting time, workload, and other factors shown by recent research, scientific evidence, and current industry experience to affect crew alertness. (A-06-10) (This recommendation supersedes Safety Recommendation A-99-45.)
>
> Require all 14 *Code of Federal Regulations* Part 121 and 135 operators to incorporate fatigue-related information similar to that being developed by the Department of Transportation Operator Fatigue Management Program into their initial and recurrent pilot training programs; such training should address the detrimental effects of fatigue and include strategies for avoiding fatigue and countering its effects. (A-06-11)

4.2 Previously Issued Recommendations Reiterated in This Report

> Require that all aircraft operated under Title 14 CFR Part 121, 125, or 135 and currently required to be equipped with a cockpit voice recorder (CVR) and flight data recorder (FDR) be retrofitted…with a crash-protected

cockpit image recording system. The cockpit image recorder system should have a 2-hour recording duration, as a minimum, and be capable of recording, in color, a view of the entire cockpit including each control position and each action (such as display selections or system activations) taken by people in the cockpit. The recording of these video images should be at a frame rate and resolution sufficient for capturing such actions. The cockpit image recorder should be mounted in the aft portion of the aircraft for maximum survivability and should be equipped with an independent auxiliary power supply that automatically engages and provides 10 minutes of operation whenever aircraft power to the cockpit image recorder and associated cockpit camera system ceases, either by normal shutdown or by a loss of power to the bus. The circuit breaker for the cockpit image recorder system, as well as the circuit breakers for the CVR and the digital FDR, should not be accessible to the flight crew during flight. (A-00-30)

Require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with a flight data recorder, and that are operating under 14 *Code of Federal Regulations* Parts 135 and 121 or that are being used full-time or part-time for commercial or corporate purposes under Part 91 to be retrofitted with a crash-protected image recording system by January 1, 2010. (A-03-65)

4.3 Previously Issued Recommendation Classified in This Report

The following previously issued recommendation is classified "Closed—Superseded" in this report:

Establish, within 2 years, scientifically based hours-of-service regulations that set limits on hours of service, provide predictable work and rest schedules, and consider circadian rhythms and human sleep and rest. (A-99-45)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

MARK V. ROSENKER
Acting Chairman

ELLEN ENGLEMAN CONNERS
Member

DEBORAH A. P. HERSMAN
Member

KATHRYN O. HIGGINS
Member

Adopted: January 24, 2006

5. Appendixes

Appendix A

Investigation and Public Hearing

The National Transportation Safety Board was initially notified of this accident on the evening of October 19, 2004. A full go-team was assembled in Washington, DC, and traveled to the accident scene. The go-team was accompanied by representatives from the Safety Board's Offices of Transportation Disaster Assistance and Public Affairs. Board Member Carol Carmody traveled to the accident site.

The following investigative groups were formed during the course of this investigation: Structures, Systems, Powerplants, Maintenance Records, Air Traffic Control, Meteorology, Operations, Human Performance, Airport/Survival Factors, Airplane Performance, and Cockpit Voice Recorder. A specialist was also assigned to analyze the flight data recorder.

In accordance with Annex 13 to the Convention on International Civil Aviation, an accredited representative from the United Kingdom's Air Accident Investigation Branch and two advisors participated in this investigation.

Parties to the investigation were the Federal Aviation Administration, Corporate Airlines, BAE Systems, Cessna/McCauley, and Honeywell. The Safety Board received submissions on this accident from Corporate Airlines (now named RegionsAir) and BAE Systems.

Public Hearing

No public hearing was held for this accident.

Appendix B
Cockpit Voice Recorder Transcript

The following is a transcript of the Fairchild model A100 CVR installed on the accident airplane. Only radio transmissions to and from the accident airplane were transcribed. The CVR transcript reflects the 30 minutes and 12 seconds before power was lost to the CVR.[1] All times are central daylight time, based on a 24-hour clock.

LEGEND

HOT	Crewmember hot microphone voice or sound source
RDO	Radio transmission from accident aircraft
CAM	Cockpit area microphone voice or sound source
CTR1	Radio transmission from first Kansas City center controller
ACFT?	Radio transmission from unidentified aircraft
CTR2	Radio transmission from second Kansas City center controller
AWOS	Radio transmission from Kirksville Automated Weather Observation System
KOPS	Radio transmission from Kirksville operations
-1	Voice identified as Pilot-in-Command (PIC)
-2	Voice identified as Co-Pilot (SIC)
-3	Voice identified as aircraft mechanical voice
-B	Sound heard over both pilot channels
-?	Voice unidentified
*****	Unintelligible word
@	Non-pertinent word
#	Expletive
- - -	Break in continuity
( )	Questionable insertion
[ ]	Editorial insertion
...	Pause

Note 1: Times are expressed in central daylight time (CDT).

Note 2: Generally, only radio transmissions to and from the accident aircraft were transcribed.

[1] Timing errors related to tape speed irregularities were observed and corrected after the initial transcript was issued, resulting in the revised transcript that is provided herein.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1906:46 **START of RECORDING** **START of TRANSCRIPT**			
1906:48 **HOT-B**	****.		
1906:50 **HOT-1**	hello.		
1906:51 **HOT-2**	[sound of laughter]		
1906:52 **HOT-1**	there, my hair was down to my breast pockets.		
1906:55 **HOT-2**	are you serious?		
1906:56 **HOT-1**	right here, I could hold my hair like this.		
1906:58 **HOT-2**	I cannot see you with long hair like....		
1906:59 **HOT-1**	just, just like that.		
1907:01 **HOT-2**	[sound of laughter]		
1907:01 **HOT-1**	I used to wear this black derby, with the uh, rim turned down. it was my concert hat. had a Fu Manchu.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1907:08 **HOT-2**	[sound of laughter] ohhh.		
1907:11 **HOT-1**	[sound of laughter] yeah, it was, it was fun.		
1907:13 **HOT-2**	[sound of laughter] I cannot imagine you being like that.		
1907:16 **HOT-1**	yeah, when I show people the pictures they say, who is this?		
1907:19 **HOT-2**	that's me.		
1907:20 **HOT-1**	who's this freak? that's me. no way.		
1907:23 **HOT-2**	d', no way. I was gonna say. we're gonna have to have a fifteen fifteen five card.		
		1907:29 **CTR1**	CorpEx fifty nine sixty six, climb and maintain one two thousand, twelve thousand.
		1907:34 **RDO-2**	one two thousand, Corporate Ex fifty nine sixty six.
1907:37 **HOT-2**	twelve 'er, thousander 'er, 'er.		
1907:38 **HOT-1**	twelve 'er thousander 'er. I detected a slight attitude on his part.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1907:44 **HOT-2**	I know I didn't miss a call the first time.		
1907:46 **HOT-1**	I'd might have to call him a #.		
1907:49 **HOT-2**	uh, better yet, QB.		
1907:51 **HOT-1**	yeah, you # QB.		
1907:57 **HOT-1**	hey no #.		
1908:09 **HOT-1**	no pilots.		
1908:16 **HOT-1**	I guess I could give it a little juice.		
1908:18 **HOT-2**	[sound of chuckle] that might help it a little bit.		
1908:21 **HOT-1**	I say, why's this # climb performance blows? it's pretty tough when you got a torque setting around eighteen.		
1908:28 **HOT-2**	[sound of chuckle]		
1908:30 **HOT-1**	yeah, you ##.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1908:32 **HOT-2**	this # thing ain't climbing....		
1908:33 **HOT-1**	[sound of chuckle]		
1908:34 **HOT-2**	...what the hell.		
1908:35 **HOT-1**	dowee.		
1908:36 **HOT-1**	oh yeah, now you're going to burn up on me you #. you # #.		
1908:43 **HOT-2**	[brief humming sound]		
1908:48 **HOT-1**	I keep pushing the call button. I don't know if it's ringing.		
1908:51 **HOT-2**	[makes verbal ringing sound]		
1908:52 **HOT-1**	give 'em something to think about. oh, something * pinging back here.		
1908:55 **HOT-2**	[makes verbal ringing sound]		
1908:56 **HOT-1**	oh, that's the shut up uh....		
1908:58 **HOT-2**	the shut up bell.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1908:58 **HOT-1**	yeah, that's it.		
1908:59 **HOT-2**	the shut up bell.		
1909:00 **HOT-1**	that's the shut the # your mouth, you #. go turbulence.		
1909:08 **HOT-2**	[sound of chuckle]		
1909:13 **HOT-1**	eleven thousand twelve thousand.		
1909:14 **HOT-B**	[sound similar to altitude alerter]		
1909:15 **HOT-2**	eleven for twelve.		
1909:18 **HOT-2**	'er thousander.		
1909:19 **HOT-1**	'er thousander.		
1909:23 **HOT-1**	[several grunting sounds]		
1909:24 **HOT-2**	* have a good time flying with you.		
1909:26 **HOT-1**	yeah, me too.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1909:27 **HOT-2**	just let you know that.		
1909:30 **HOT-1**	gotta have fun.		
1909:31 **HOT-2**	that's truth man. gotta have the fun.		
1909:35 **HOT-1**	too many of these # take themselves way too serious, in this job. I hate it, I've flown with them and it sucks. a month of # agony.		
1909:39 **HOT-B**	[sound similar to frequency change alert]		
1909:47 **HOT-1**	all you wanna do is strangle the ## when you get on the ground.		
1909:50 **HOT-2**	oh'.,.. @ [sound of laughter]		
1909:52 **HOT-1**	oh *, yeah, oh well, he was one but I didn't, I didn't have to fly with him that much 'cause....		
1909:56 **HOT-2**	I know.		
1909:57 **HOT-1**	it was kinda a fluke. but uh, some of the guys that aren't here any more you wanted to just # kick 'em in the #. lighten the # up #.		
1910:09 **HOT-2**	have you ever flown with @?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1910:11 **HOT-1**	yeah.		
1910:12 **HOT-2**	how's he?		
1910:12 **HOT-1**	a #.		
1910:13 **HOT-2**	is he?		
1910:14 **HOT-1**	yeah. at least he was, three and a half years ago.		
1910:21 **HOT-2**	see, I'm glad I'll never have to fly with him 'cause he's a Nashville guy. but for being a Nashville guy, he's up in St. Louis all the time.		
1910:29 **HOT-1**	yeah, the difference between Nashville and the rest, lot of those guys, @ uh.... well not @@, @@and @ and @ uh.... can't think of his last name. there's three @ that were from Nashville that were in the crew room today.		
1910:45 **HOT-2**	oh God.		
1910:46 **HOT-1**	and uh, @@@@ whatever the hell they call them.		
1910:51 **HOT-2**	blow me.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1910:52 **HOT-1**	blow me. yeah, lotta guys were Nashville based. @, it just really doesn't mean anything. I mean they they come out of Nashville but they fly a lot of the routes up here. same # routes. the only difference is that you may get an Atlanta run and a Tri-Cities run, which is kinda fun. that's like working for a different company, 'cause you fly over slightly mountainous area, which is kinda cool.		
1911:04 **HOT-B**	[sound of tone similar to altitude alerter]		
1911:19 **HOT-2**	yeah, we get the shaft.		
		1911:21 **RDO-1**	####.
		1911:25 **ACFT?**	nice tone.
1911:26 **HOT-1**	[sound of chuckle]		
1911:30 **HOT-2**	that was a good one.		
1911:32 **HOT-1**	[sound of chuckle] yeah, I had to share that.		
1911:44 **HOT-2**	[sound of sigh]		
1911:47 **HOT-1**	cruise power cruise check. you push his foot away?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	CONTENT	TIME (CDT) & SOURCE	CONTENT
1911:52 **HOT-2**	trying to # close it up. all right. stop # around with it.		
1911:59 **HOT-1**	cruise power, cruise check.		
1912:08 **HOT-2**	all you do is push the curtain to the side a little bit. it's like man....		
1912:15 **HOT-1**	some people I invite their feet up to make them comfortable but # I'll, I, I've dropped my book on em purposely one time, right on the top part of the arch of the foot.		
1912:26 **HOT-2**	oooh.		
1912:27 **HOT-1**	oh yeah, they were #. I told 'em to remove his foot twice. and then I dropped them the uh, red book....		
1912:33 **HOT-2**	[sound of grunting] your power levers.		
1912:34 **HOT-1**	...right on 'em.		
1912:35 **HOT-2**	[sound of laughter] the power spiked up a little bit.		
1912:41 **HOT-1**	yyyeeeaa.		
1912:43 **HOT-2**	you want it at ninety seven not ninety seven and a quarter.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1912:46 **HOT-1**	yeah.		
1912:47 **HOT-2**	oh well. tough #.		
1912:49 **HOT-1**	that will do.		
1912:51 **HOT-2**	cruise power.		
1912:51 **HOT-1**	all I'm thinking of is a Philly # cheese steak and an iced tea.		
1912:55 **HOT-2**	sounds good. cruise power's set. altimeters are two niner niner zero, set and cross-checked.		
1913:00 **CAM**	[sounds similar to CVR tape splice]		
1913:02 **HOT-2**	how did I get two niner niner zero?		
1913:03 **HOT-1**	cause you're a #.		
1913:04 **HOT-2**	* two niner niner two?		
1913:06 **HOT-1**	'cause you never set it when we changed it to Alpha or whatever it was. soon as he was telling us that they cleared us onto the runway.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1913:16 **HOT-2**	and I've been sitting here living a lie for the rest for the the last twenty minutes.		
1913:21 **HOT-1**	yeah, you lying scum bucket.		
1913:22 **HOT-2**	# boost pumps are off, pressurization's checked and external lights....		
1913:25 **HOT-1**	you blustering scabby pustuile.		
1913:27 **HOT-2**	are externalized. your # cruise checklist is # done.		
1913:31 **HOT-1**	thank you.		
1913:32 **HOT-2**	you're welcome.		
1913:33 **HOT-B**	[sound of tone similar to frequency change alert]		
		1913:34 **AWOS**	not available....
1913:36 **HOT-1**	you get a ##.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
		1913:37 **AWOS**	...Kirksville Regional Airport automated weather observation zero zero one three Zulu. wind zero four zero at zero six. visibility four. mist. sky condition overcast three hundred....
1913:54 **HOT-1**	ahh.		
		1913:55 **AWOS**	...temperature zero niner Celsius. dew point zero niner Celsius. altimeter two niner niner five. remarks....
1914:06 **HOT-1**	we're not getting in.		
1914:10 **HOT-2**	Kirksville uh.... that was Quincy that the ILS... was out of service.		
1914:18 **HOT-1**	we don't have an ILS.		
1914:19 **HOT-2**	I know.		
1914:20 **HOT-1**	three hundred sixty feet.		
1914:21 **HOT-2**	Jesus Christ. [spoken in a whispered voice]		
1914:26 **HOT-2**	go all this # way.		
1914:30 **HOT-2**	well, let's try it.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1914:31 **HOT-1**	yeah, we'll try it.		
1914:39 **HOT-2**	that # sucks.		
1914:41 **HOT-1**	does suck.		
1914:42 **HOT-2**	[sound of sigh]		
1914:45 **HOT-1**	[sound of humming]		
1914:49 **HOT-1**	so it went down.		
1914:50 **HOT-2**	[sound of humming]		
1914:51 **HOT-1**	but that's a # a # AWOS there anyway.... we'll see what happens.		
1915:03 **HOT-1**	[sound of humming, yawning and tapping] I don't want to get, go all the way out here for nothing tonight. it's gonna blow #..... it's gonna blow the butt, blow the butt, blow the butt. what have we got here. three sixty, thirteen twenty.		
1915:32 **HOT-1**	I'll be so happy when we have an ILS everywhere we go.		
1915:42 **HOT-2**	what'd you say?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1915:43 **HOT-1**	one twenty one. I said I'll be so happy we'll have an ILS, the next job everywhere we go will be an ILS.		
1915:47 **HOT-2**	yep.		
1915:48 **HOT-1**	[sound of burp] I thought we were gonna have it easy tonight. it was gonna be....		
		1915:58 **CTR1**	**** fifty nine sixty six, contact Kansas City center one three two point six.
1916:02 **HOT-2**	I, I don't know if that was us.		
1916:04 **HOT-1**	yeah.		
1916:04 **HOT-2**	it was?		
1916:05 **HOT-1**	one two three point six.		
		1916:06 **RDO-2**	Kansas City one thirty two point six, CorpEx fifty nine sixty six.
1916:13 **HOT-B**	[sound similar to frequency change alert]		
1916:17 **HOT-2**	man, I'm glad I caught that. man this frequency's way too loud.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1916:23 **HOT-1**	turn it down. we don't give a # about company.		
		1916:24 **RDO-2**	Kansas City, CorpEx fifty nine sixty six is checking in with you one two thousand. good evening.
		1916:28 **CTR2**	CorpEx fifty nine sixty six, Kansas City center, good evening. uh, do you have the Kirksville weather yet?
		1916:34 **RDO-2**	yes sir, we do.
		1916:36 **CTR2**	CorpEx fifty nine sixty six, roger. uh, what approach you want over there?
		1916:41 **RDO-2**	we'd like vectors for the localizer DME runway three six into Kirksville.
		1916:45 **CTR2**	roger. have your request.
1916:50 **HOT-2**	ah, I remembered.		
1916:50 **HOT-1**	very good.		
1917:06 **HOT-2**	I'm a #.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1917:10 **HOT-2**	all right, we got supposedly six miles before we have to flip it up. want me to flip it.		
		1917:17 **CTR2**	CorpEx fifty nine sixty six, descend at pilots discretion maintain eight thousand.
1917:20 **HOT-1**	sure.		
		1917:19 **RDO-2**	pilot's discretion down to eight thousand, CorpEx fifty nine sixty six.
1917:23 **HOT-1**	discretion eight thousand.		
1917:25 **HOT-2**	discretion eight thousand my friend. [sound of humming]		
1917:28 **HOT-1**	descent checklist when you get a chance.		
		1917:28 **CTR2**	CorpEx fifty nine sixty six, fly your present heading vectors for localizer three six approach.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
		1917:35 **RDO-2**	present heading vectors for a localizer, fifty nine sixty six.
1917:49 **HOT-2**	one ten.... would be that one... that. okay, your descent check-list. [sound of humming] altimeters are... two niner niner.... five... set right.		
1918:21 **HOT-1**	niner five. set. left.		
1918:24 **HOT-2**	okay, altimeters are set and crosschecked. fuel pres, pressuriza-tion is set and checked. fuel balance is .... go ahead and do it.... checked. and seat belt sign/external lights are on. your descent checklist is complete. one ten. one eleven point five.		
1918:48 **HOT-1**	thank you.		
1918:51 **HOT-2**	well you got it *, up already?		
1918:53 **HOT-1**	DME on uh, three if you want it. I guess there's DME on the localizer. looks like there's a D there is there?		
1919:04 **HOT-2**	yeah, there's a localizer DME.		
1919:06 **HOT-1**	yeah. that would make sense, wouldn't it?		
1919:09 **HOT-2**	yes it would.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1919:09 **HOT-1**	yes it would.		
1919:11 **HOT-2**	yes in deede doody, daudy, deede.		
1919:13 **HOT-1**	yes in deede doody, daudy.		
1919:20 **HOT-1**	[sound of humming]		
		1919:37 **AWOS**	wind zero four zero at zero five....
1919:39 **HOT-1**	the one bad thing about these covers is they reflect the light off of this of thing too much and you can't see #. thirteen twenty. oh shut the # up back there.		
		1919:42 **AWOS**	...visibility three. mist. sky condition overcast three hundred. temperature zero niner Celsius. dew point zero niner Celsius. altimeter two niner niner five.
1920:05 **HOT-2**	[sound of sigh]		
1920:20 **HOT-2**	it's three miles and mist now. [sound of sigh]		
1920:22 **HOT-1**	*. really?		
1920:25 **HOT-2**	yep.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1920:25 **HOT-1**	so it's going down the tubes.... #.		
1920:35 **HOT-2**	[sound of whistling]		
1921:27 **HOT-1**	Charlie India.		
1921:44 **HOT-2**	you know, I think you're gonna need to just shut the # up.		
1921:49 **HOT-1**	love to poke my head back around and say that. you know ladies and gentlemen uh, we've thought about it....		
1921:55 **HOT-2**	[sound of laughter] it was unanimous up here.		
1921:57 **HOT-1**	* we've come to the conclusion that you people should all shut the # up.		
1921:59 **HOT-B**	[tone similar to altitude alerter]		
1922:02 **HOT-2**	niner thousander for eight thousander.		
1922:04 **HOT-1**	niner thousander for eight thousander. today er. tonight er.		
1922:06 **HOT-2**	tonight er.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1922:07 **HOT-B**	[continuation of above sentences for several repetitions]		
1922:16 **HOT-2**	five point to KEMMY, huh?		
1922:17 **HOT-2**	on the Richter scale.		
1922:20 **HOT-1**	five point two is KEMMY, correct?		
1922:22 **HOT-2**	that is correct.		
1922:22 **HOT-1**	roger.		
1922:23 **HOT-2**	roooooooooger.... almost sounded like a burp, didn't it?		
1922:34 **HOT-1**	did.		
1922:36 **HOT-2**	amazing. we're forty three point eight miles from IRK, eye rk.		
1922:44 **HOT-1**	"e kirk".		
1922:59 **HOT-2**	[sound of sigh] let's see. speeds are off the fifteen five card. fifteen, twenty one and thirty. be darned. I already had that in there.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1923:16 **HOT-1**	thank you.... localizer DME runway three six. one eleven five.		
		1923:117 **CTR2**	CorpEx fifty nine sixty six, descend at pilot's discretion, maintain three thousand.
		1923:23 **RDO-2**	pilot's discretion maintain three thousand, CorpEx fifty nine sixty six.
1923:27 **HOT-1**	discretion three thousand.		
1923:28 **HOT-2**	three thousand.		
1923:29 **HOT-1**	one eleven point five, three fifty seven's the inbound. twenty five hundred at KEMMY. thirteen twenty is our MDA. and we have a three hundred sixty foot approach set in the radar altimeter.		
1923:43 **HOT-2**	three sixty. [sound of yawn] aw, I had it on three sixty.		
1923:47 **HOT-1**	thank you.		
1923:48 **HOT-2**	you're welcome.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1923:50 **HOT-1**	nine sixty six for the appr, airport elevation. nine sixty four is the touchdown zone elevation. speeds as previously briefed, fifteen, twenty one and thirty. if we have to go missed we'll set max power, flaps ten positive rate, gear up.... and we'll climb to three thousand feet then direct Kirksville VOR, and hold, and that will be a parallel.... parallel entry, or teardrop, either one.		
1924:17 **HOT-2**	oh, I was being.... teardrop.		
1924:18 **HOT-1**	it's probably a teardrop, I'll go with teardrop.... and I'll have you walk me through that if we need it.		
1924:25 **HOT-2**	no problem.		
1924:26 **HOT-1**	and that's it. questions?		
1924:34 **HOT-2**	negative. [sound of humming]		
1924:36 **HOT-1**	negative, we're going into the crap. look, ooh, it's so eerie and creepy.		
1924:38 **HOT-2**	ooh, negative.		
1924:40 **HOT-1**	get a suffocating feeling when I see that.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1924:48 **HOT-2**	[pilot makes barking sound followed by groan]		
1924:58 **HOT-1**	I'm drowning.... MSA is thirty one hundred.		
1925:00 **HOT-2**	correcto mundo.		
1925:02 **HOT-1**	how is he able to put us down at three thousand?		
1925:05 **HOT-2**	beats the # out of me.		
1925:16 **HOT-1**	thirty five miles from the, east.		
1925:19 **HOT-2**	well we can level off at thirty one hundred feet. how about that?		
1925:26 **HOT-1**	yeah... yeah baby.		
1925:44 **HOT-2**	cause we know our #.... [sound of yawn]		
1925:46 **HOT-1**	[sound of humming]		
1925:53 **HOT-2**	[sound of humming] and they have a VASI on the left hand side.		
1926:00 **HOT-1**	yeah. wish we had an ILS on the front hand side.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1926:00 **HOT-2**	[sound of laughter] yeah, that'd be nice.		
1926:03 **HOT-1**	nice.		
		1926:52 **CTR2**	CorpEx fifty nine sixty six, turn ten degrees right now vectors to localizer uh, uh, runway three six final approach course.
		1927:01 **RDO-2**	ten right for vectors for final approach course for runway three six, CorpEx fifty nine sixty six.
		1927:05 **CTR2**	CorpEx fifty nine sixty six, say your new heading.
1927:10 **HOT-1**	three one zero.		
		1927:10 **RDO-2**	three one zero, CorpEx fifty nine sixty six.
		1927:13 **CTR2**	thank you.
1927:15 **HOT-1**	new heading.		
1927:18 **HOT-2**	just ask, say new heading.		
1927:19 **HOT-1**	new heading.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1927:20 **HOT-2**	[sound of chuckle] I'd like to do that just once to see if I'd get a crack.		
1927:29 **HOT-2**	all right smart ass. I need you to hold. [sound of chuckle]		
1927:34 **HOT-1**	no say uh, cancel IFR.		
1927:38 **HOT-2**	yeah, noooooo. [sound of whistling] all right, we're within range, again.		
1927:53 **HOT-1**	again.		
1927:55 **HOT-2**	got one?		
1927:55 **HOT-1**	I got one.		
		1928:03 **RDO-2**	Kirksville ops, CorpEx fifty nine sixty six.
		1928:11 **KOPS**	fifty nine sixty six.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
		1928:11 **RDO-2**	yeah, we're within range. it's gonna be about one point seven on the fuel.
		1928:15 **KOPS**	one point seven.
		1928:18 **RDO-2**	see ya a little bit.
1928:23 **HOT-2**	back on one.		
1928:25 **HOT-1**	no changes.		
1928:26 **HOT-2**	no, no a changeee.		
1928:33 **HOT-2**	[sound of humming]		
1928:46 **HOT-1**	how's uh, Kirksville looking weather wise? getting' any worse?		
		1928:50 **AWOS**	... niner Celsius. dew point zero niner Celsius. altimeter two niner niner five. remarks, thunderstorm, information not available....
1929:00 **HOT-1**	temp 'n dew point's right where you don't want it.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1929:01 **HOT-2**	yeah, dead nuts.		
		1929:03 **AWOS**	... Kirksville Regional Airport, Automated Weather Observation zero zero two eight Zulu. wind zero three zero at zero six. visibility three. mist. sky condition overcast three hundred. temp....
1929:19 **HOT-2**	still three hundred.		
1929:21 **HOT-1**	yep.		
1929:27 **HOT-2**	[sound of yawn] *. how would you like approach checklist?		
1929:33 **HOT-1**	that would be a beautiful thing.		
1929:36 **HOT-2**	all right, approach briefing?		
1929:37 **HOT-1**	complete.		
1929:39 **HOT-2**	ah let's see, landing data. we briefed, right?		
1929:41 **HOT-1**	* left.		
1929:41 **HOT-2**	flight instruments and radios, set checked on the right?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	CONTENT	TIME (CDT) & SOURCE	CONTENT
1929:43 **HOT-1**	set checked left.		
1929:45 **HOT-2**	* * crossfeed on normal. passenger briefing is started. approach checklist is complete.		
1929:50 **HOT-1**	thanks.		
1929:51 **HOT-2**	sure.		
1929:57 **HOT-B**	[tone similar to altitude alerter]		
1929:59 **HOT-2**	four thousand three thousand.		
1930:00 **HOT-1**	four thousand for three thousand.		
1930:13 **HOT-2**	actually we should do thirty-one hundred.		
1930:15 **HOT-1**	yeah, that's what I'm gonna do.		
1930:17 **HOT-2**	should I put it on here?		
1930:18 **HOT-1**	yep. is a good thing.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
		1930:30 **CTR2**	CorpEx fifty nine sixty six uh, one one miles south of uh, KEMMY. turn right heading three, three zero. maintain three thousand until established on the localizer. cleared localizer DME runway three six approach at Kirksville.
		1930:41 **RDO-2**	three thousand feet 'til established uh, heading three three zero. cleared for the localizer DME runway three six into Kirksville CorpEx fifty nine sixty six.
1930:50 **HOT-2**	thirty three, three thousand 'til established. cleared for the approach.		
1930:54 **HOT-1**	cleared the approach.		
1931:00 **HOT-2**	cleared for the approach.		
1931:01 **HOT-1**	# the approach. you're #. approach #. [sound of chuckle]		
1931:11 **HOT-2**	[sound of chuckle] ** [vibrating lip noise] that's funny when it happens too. [vibrating lip noise] is that a #? yeah. [sound of laughter] he #. thirty one.		
1931:27 **HOT-1**	thirty *.		
1931:30 **HOT-1**	[humming sound] thank you.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1931:34 **HOT-2**	course alive. cross check, no flags except for the vertical.		
1931:41 **HOT-1**	the wertical. get up there ##. keep it slow. all the time we need. [sound of humming]		
1932:06 **HOT-1**	let's go flaps ten and we'll configure early too.		
1932:11 **HOT-2**	all right. flaps ten....		
1932:12 **HOT-1**	give ourselves as much time as we can.		
1932:13 **HOT-2**	selected indicating ten.... since we're not going to doing holds like that one #.		
1932:22 **HOT-1**	right.		
1932:24 **HOT-2**	**.		
1932:30 **HOT-1**	and it, was it five point?		
1932:31 **HOT-2**	five point two.		
1932:32 **HOT-1**	five point two.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1932:33 **HOT-2**	I'll call it out for you.		
1932:35 **HOT-1**	okay. we can go to what, twenty five right now?		
1932:37 **HOT-2**	twenty five right now.		
1932:38 **HOT-1**	okay, gear down, flaps twenty, before landing check.		
1932:45 **HOT-2**	[sound of a sigh] all right.		
1932:46 **HOT-2**	dow, gear down, three green.		
1932:48 **HOT-1**	three green.		
1932:49 **HOT-2**	uh, prop syncs are off, speeds are high. flaps selected indicating twenty. hydraulic brake pressure normal. standing by the flows.		
1933:07 **HOT-1**	[sound of humming]		
1933:17 **HOT-2**	twenty five.		
		1933:41 **CTR2**	CorpEx fifty nine sixty six, frequency change approved. report the down time on this frequency or through flight service.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
		1933:46 **RDO-2**	all right, frequency change approved. we'll cancel with you on the ground, CorpEx fifty nine sixty six. so long.
		1933:51 **CTR2**	roger.
1933:52 **HOT-B**	[sound similar to frequency change alert]		
1933:55 **HOT-1**	make sure those lights are up please.		
1933:56 **HOT-2**	all right.		
1933:57 **HOT-1**	thanks.		
		1933:57 **RDO-2**	[sound similar to seven microphone clicks]
1934:04 **HOT-2**	seven times I clicked it. I cleeted it.		
1934:08 **HOT-1**	what we can do is, well is call Kirksville ops and ask them to confirm that they're up.		
1934:13 **HOT-2**	all right.		
1934:13 **HOT-1**	that would be kinda nice.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
		1934:14 **RDO-2**	Kirksville ops, CorpEx fifty nine sixty six.
1934:22 **HOT-2**	aw speeds.		
		1934:21 **KOPS**	fifty nine sixty six.
		1934:23 **RDO-2**	yeah, can you tell me if uh, the approach lights are up?
		1934:37 **KOPS**	lights are on.
		1934:39 **RDO-2**	cool, thanks.
1934:51 **HOT-1**	come on you ##.		
1934:52 **HOT-2**	# it. pig, isn't it?		
1934:55 **HOT-1**	sure is.		
1935:06 **HOT-1**	what happened to our identifier?		
1935:09 **HOT-B**	[sound of Morse code identifier] R-K.		
1935:10 **HOT-1**	I don't have it any more. do you? localizer?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1935:16 **HOT-B**	[sound of Morse code identifier] I-I-R-K.		
1935:19 **HOT-2**	I got it.		
1935:20 **HOT-1**	okay.		
1935:22 **HOT-1**	DME went off line.		
1935:26 **HOT-2**	not on my side. five point seven.		
1935:28 **HOT-1**	okay.		
1935:29 **HOT-2**	five point six.		
1935:30 **HOT-1**	okay, mine's back.		
1935:31 **HOT-2**	five point five.		
1935:38 **HOT-1**	I can hear it.		
1935:39 **HOT-2**	there you go, KEMMY. down to thirteen twenty.		
1935:42 **HOT-1**	thirteen twenty, here we go.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1936:02 **HOT-1**	when we get within a hundred feet if you'd uh, arm that uh....		
1936:06 **HOT-2**	disarm it?		
1936:06 **HOT-1**	... director again yeah uh, altitude.		
1936:08 **HOT-2**	oh for * [one member heard "altitude"], okay.		
1936:18 **HOT-1**	c'mon, go down there.		
1936:23 **HOT-2**	five hundred, four hundred feet to go.		
1936:24 **HOT-1**	*.		
1936:30.6 **HOT-3**	five hundred.		
1936:33.9 **HOT-2**	thirteen twenty.		
1936:35.7 **HOT-1**	what do you think?		
1936:35.9 **HOT-1**	thank you.		
1936:36.8 **HOT-1**	I can see ground there.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1936:37.2 **HOT-3**	minimums, minimums.		
1936:41.9 **HOT-2**	I can't see #.		
1936:43.5 **HOT-1**	yeah, oh there it is. approach lights in sight.		
1936:44.2 **HOT-3**	two hundred.		
1936:44.7 **HOT-2**	* in sight.		
1936:46.6 **HOT-2**	continue.		
1936:47.7 **HOT-1**	we get rid of the director.		
1936:48.6 **HOT-B**	[sound of beep]		
1936:50.5 **CAM**	[sound similar to increase in engine RPM]		
1936:50.5 **HOT-1**	getting a little slow.		
1936:50.6 **HOT-2**	flaps thirty five?		
1936:51.9 **HOT-1**	no....		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME (CDT) & SOURCE	**CONTENT**	**TIME (CDT) & SOURCE**	**CONTENT**
1936:52.2 **HOT-3**	sink rate.		
1936:52.8 **HOT-1**	...no.		
1936:53.2 **HOT-2**	trees.		
1936:54.0 **HOT-B**	[sound similar to stall warning horn]		
1936:54.4 **HOT-1**	no, stop.		
1936:55.2 **CAM**	[sound of impact]		
1936:56.6 **HOT-1**	oh, my God.		
1936:57.0 **CAM**	[sounds of numerous impacts]		
1936:57.5 **HOT-2**	holy #.		
1936:58.6 **END of TRANSCRIPT** **END of RECORDING**			

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